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CONTENTS

CONSTRUCTION

LABOR, EQUIPMENT RATIOS IN CAPITAL INVESTMENT CHANGE WITH CIRCUMSTANCES

Moscow IZVESTIYA AKADEMII NAUK SSSR: SERIYA EKONOMICHESKAYA in Russian No 2, Mar-Apr 81 (signed to press 26 Mar 81) pp 64-77

[Article by V. K. Fal'tsman and A. Yu. Ozhegov: "Proportions in Developing Machinebuilding and Construction"]

[Text] The article studies proportions in developing capital-forming branches of the economy, and the effect of various factors on the technological structure of capital investment is pointed out. A methodology for computing the influence of technologies and the reproduced and branch structures of capital investment on the dynamics of their technological structure is proposed. Questions of forecasting the technological structure of capital investment are examined.

The ratio between the production of equipment in machinebuilding and construction and installing work volume is one of the most important ratios in the national economy. In forecasts it cannot be determined as a result of self-contained computations of the development of machinebuilding and construction work. In this case, in order to provide for a balancing, an analysis and forecast of the factors that form this proportion are necessary. The proportion in the distribution of investment-type deliveries of capital-forming branches--machinebuilding and construction--is expressed in the technological structure (T-structure) of capital investment.

The T-structure reflects the ratio of expenditures, first, for acquiring equipment, tools and implements, and, second, for construction and installing work (SMR), as well as for design, survey and other operations and expenditures. The share of the latter expenditures has a tendency to grow (from 7 percent in 1955-1960 to 10 percent in 1971-1975 and 13 percent in 1978-1979 [12, p 365]). However, what interests us most of all are the dynamics of the share of SMR and the share of equipment. A decrease in the first and an increase in the second reflect a speedup in the replacement of equipment and in the updating of fixed capital on the basis of reequipping and rebuilding enterprises and growth in the machine to live labor ratio. The report of Chairman of the USSR Council of Ministers Comrade N. A. Tikhonov, "The Main Directions for Economic and Social Development of the USSR During 1981-1985 and During the Period up to 1990," emphasizes the necessity for improving the capital investment structure and increasing the share of capital for rebuilding and reequipping.

A vast literature has been dedicated to the question of increasing the share of the active portion in capital investment and fixed capital. Studies by Ya. B. Kvasha, V. P. Krasovskiy, L. M. Smyshlyayeva, N. T. Chertko and others have enabled a methodological concept for analyzing and forecasting the technological structure to be formulated, in accordance with which it is formed under the influence of the branch and reproduced structure of capital investment, technical progress, siting, and the value factor [1 and 2]. In turn, the scale and pace of development of the economy and of foreign trade affect these factors.

The imperfect state of existing statistical reporting, in which that portion of construction work that is connected with the creation of equipment of construction origin (the cost of many structures, blast furnaces for instance) has not been singled out, should be noted. As a result, certain progressive changes in technology (the replacement of the transport of oil in railroad tank cars by oil-pipeline transport and of various mechanical by nonmechanical technologies) lead to a reduction in the share of equipment in capital investment. Also the statistics of the reproduced structure of capital investment, in which the breakdown of expenditures for rebuilding, expansion and reequipping still is not precise enough, have not been improved. Such a breakdown is complicated objectively by the fact that often all three forms of reproduction are going on simultaneously at one enterprise or construction project.

The authors have studied the T-structure of capital investment, based upon data of the last 20 years, singling out various periods in which the influence of one factor or another on the share of equipment was most significant.

The share of construction and installing work in total capital-investment volume in the national economy over a 15-year period (1961-1975) fell from 65 to 59 percent, that is, by 6 points, but by 5 points--from 53 to 48 percent--for productive-type capital investment [10, pp 350, 351]. Thus a long-term but very slow trend toward improvement of capital investment's T-structure was noted. High stability of the technological structure was a consequence of lengthy retention of the existing type of reproduction of fixed capital and sluggishness in replacing some technological methods of production by others. Moreover, the active portion in industrial-production fixed capital during 1960-1977 rose by about 1.2 points, while in the USA it has been increasing annually by about 0.5 point [10, p 134].

In the first 4 years of the 10th Five-Year Plan the long-term trend toward reducing the share of construction and installing work not only was preserved but was sharply accelerated. The share of SMR in all capital investment of the national economy was 63 percent in 1965, 62 percent in 1970, 59 percent in 1975 and 53 percent in 1979, that is, out of 10 points of reduction in the share of SMR in 15 years, 6 of the points came during the last 5 years [12, p 364]. How is this circumstance explained?

To a definite extent, reduction in the share of SMR has been associated with a reduction in the share of nonproductive capital investment, primarily of expenditures on housing construction (in which the SMR share in 1977 was 93.3 percent). The share of housing construction in the national economy's total capital investment volume was reduced from 17.2 percent to 15.3 percent during the Eighth Five-Year Plan, to 15.3 percent during the Ninth, and to 13.7 percent in 1976-1979 [12, p 367]. More than half of the reduction in the share of SMR in the national economy's investment, from 63 percent in 1966-1970 to 61 percent in 1971-1975, was

caused by the effect of this factor. As for the share of SMR in production-type capital investment, it was reduced during the indicated five-year plans by about 1 point (from 51 to 50 percent) [12, p 365]. Later, the effect of the dynamics of the share of investment in housing construction on the T-structure of capital expenditures, although it was retained, was no longer determining. Beginning with 1975, a rapid reduction in the share of SMR has been observed, both in total capital investment volume and in production investment. For some branches of industry this reduction fluctuated within the 6-16 point range from 1972 to 1978, and for industry as a whole it exceeded 10 points. Since the reduction was observed throughout all large branches of material production, it can no longer be explained by interbranch structural shifts.

Table 1

Dynamics of the Share of Construction and Installing Work in Capital Investment in Recent Years, in Percent*

Branches	1972	1973	1974	1975	1976	1977	1978
The national economy as a whole.........	62	60	60	59	57	56	54
Facilities for production purposes......	51	50	50	48	46	45	44
Industry.............................	53	52	51	48	46	45	43
Power engineering.....................	61	61	61	59	57	57	55
Coal industry.........................	53	51	50	48	46	45	44
Chemical industry.....................	58	58	57	56	53	50	43
Machinebuilding (11 ministries).........	47	46	46	39	39	36	34

*Computed to take into account the data of [11, pp 339-341] and [14, p 76].

Attempts have been made to explain this situation by increase in equipment prices and by the introduction since 1 January 1976 of SMR reduction coefficients. The conclusion about the dominating influence of price shifts is not confirmed by USSR TsSU [Central Statistical Administration] data about the recomputation of comparable budget-estimating prices as of 1 January 1969, which were drawn up to consider the new wholesale prices for domestic equipment that were introduced on 1 January 1974, the SMR reduction coefficients, and the results of a reevaluation of fixed capital in 1972. At the same time, it follows from the computations of many authors that estimated prices for equipment per unit of capacity are rising [3].

As our studies indicated, higher costs for imported equipment are playing a major role in the rise in prices. It is this factor that has been affecting the technological structure of capital investment appreciably in recent years. Thus, out of 4.1 percentage points of increase in the share of equipment in capital investment in the national economy during 1976-1978 over 1971-1975 (35.2 percent versus 31.1 percent), 1.4 points, or 34 percent of the total change, were caused by the increased cost of imported equipment, according to the authors' computations.

The automation of production also is affecting the technological structure of capital investment. A portion of the funds for automation and computer equipment goes directly to investment-type deliveries of equipment, which leads to a growth in the share of equipment, through expensive machinery, where the share of construction and installing work expenditures is small. In the case where instruments and automating and computing equipment are shipped to outfit machinebuilding output, this leads to an increased cost of the equipment, with practically no increase in expenditures for the construction and installing work associated with its

installation. As a result, the share of equipment in capital investment is growing. In 1971-1975, 12.4 percent of the capital investment for equipment for the whole national economy went for instruments, automation and computer equipment, and in 1976-1978 the figure was 15.6 percent.* The share of equipment in capital investment rose by 0.8 percentage points because of the effect of this factor.

The mechanization of production during the period being studied affected the T-structure of capital investment to a lesser degree. In particular, the share of elevating and conveying equipment in total capital investment for equipment acquisition was 2.0 percent in 1966, 1.9 percent in 1970, 1.6 percent in 1975 and 1.8 percent in 1977.**

Let us now examine how changes in the technological structure of capital investment were associated with its reproduced structure, and also with the dynamics of the share of various production facilities and technologies.

"Reproduced structure" is usually understood to mean the share of capital investment in new construction on the one hand, and for reconstruction, expansion and reequipping existing enterprises on the other. A change of this ratio in the direction of a reduction in new construction has been observed recently, which, however, does not coincide with the dynamics of the T-structure. Thus the share in capital investment for nine large branches of industry was (in percents):

Components	Five-year plans 7th	8th	9th
Equipment	38	42	42
Reconstruction, expansion and reequipping	55	54	59

The share of reconstruction, expansion and reequipping during the Eighth Five-Year Plan fell below the level for the Seventh Five-Year Plan, at a time when the share of equipment in capital investment had risen by 4 points. The Ninth Five-Year Plan presented the opposite picture, when, despite a substantial (5-point) growth in the share of reconstruction, the equipment share remained stable. All this is explained by the insignificance of the difference between the T-structure of capital investment that goes to reconstruction and expansion and that allocated to new construction. According to our computations (table 2), on the average for the nine branches of industry, the difference in the SMR share between reconstruction and construction was about 2 points. For some branches (coal, ferrous metallurgy, machinebuilding and light industry) the share of SMR for reconstruction was even higher than for new construction.

The insignificance of the difference in the T-structure of capital investment during new construction and reconstruction (if it is considered that, even for expansion, the SMR share is much less than for new construction) evidently should explain the higher cost per unit of construction work during reconstruction in comparison with new construction. According to data that relates to the reconstruction of 120 industrial facilities in Moscow, labor expenditures and building-materials consumption during reconstruction are higher than during new construction by, respectively, 35 and 8 percent; 1 cubic meter of footing under equipment costs 6-8 percent more during reconstruction than during new construction [4, p 150]. One of the main causes of high labor intensiveness and metals intensiveness, and,

*Computed on the basis of data of [12, pp 181, 366 and 367].

**Computed in accordance with the data of [12, p 183].

Table 2

Share of Construction and Installing Work of Elements of the Reproduced Structure of Capital Investment in 1977, Percent*

Branches of industry	SMR share, total	Route: New construction	Reconstruction	Expansion	Reequipping	Upkeep of capacity
Power engineering..........	57.4	68.6	66.2	61.0	61.1	42.9
Coal industry..............	44.9	72.4	75.6	67.9	12.0	56.0
Ferrous metallurgy.........	50.8	58.3	58.8	56.9	27.2	65.0
Chemicals and petrochemicals	49.7	57.2	54.9	51.8	30.8	34.8
Machinebuilding (11 ministries)..........	35.9	49.4	52.2	48.0	7.3	--
Forestry...................	38.4	65.4	65.4	47.8	14.6	62.1
Building materials..........	46.1	66.2	61.6	60.8	30.1	13.1
Light industry.............	34.2	56.0	63.7	60.6	7.9	--
Food industry..............	34.5	71.9	65.4	41.0	21.2	29.7
Industry, overall..........	44.6	63.4	66.1	52.0	14.6	34.4

*The authors' computations, based on the data of [12, p 369] and [14, p 76].

consequently, of the cost of reconstruction, is the orientation of the material and equipment base of the contracting construction organizations, which has existed for decades, and of the structure of the output of construction machinery, for new construction. Moreover, as research conducted at Urals enterprises has indicated, during reconstruction both the active and the passive portion of the assets have to be rebuilt, since the obsolete production premises do not allow modern large-dimension equipment to be emplaced and do not meet the requirements for sanitation and safety [5, pp 30, 31].

As is evident from table 2, in only 4 of 9 branches of industry (power engineering, chemicals, building materials, and food) was the SMR share in capital investment for reconstruction lower than for new construction. Because of the fact that not by far does reconstruction always provide winnings in time, it can be considered, with known reservations, that these branches alone are manifesting a certain propensity for reconstruction under existing conditions. They are increasing production capacity with a partial savings of investment in passive fixed capital, as a result of which the prerequisites are created for reducing specific capital investment.

Thus, the nonconformance of the dynamics of the share of reconstruction, expansion and reequipping with the T-structure evidently is caused by the excessive latitude, ambiguity and economic inhomogeneity of the first indicator. Meanwhile, an increase in expenditures for reequipping existing enterprises and for the upkeep of their capacity can cause substantial growth in the share of equipment in the T-structure. The total data of table 2, according to which the SMR share in capital investment in these reproduced elements makes up, respectively, 15 and 34 percent, while the figures are 66 and 63 percent for reconstruction and new construction, leads to this conclusion.

The existing difference in the T-structure of capital investment for reequipping and for upkeep of capacity is not characteristic for all industries. For example,

in power engineering the SMR share in expenditures for the upkeep of capacity differs little from the same indicator for new construction and reconstruction, and for reequipping it practically does not differ at all. In ferrous metallurgy the share of SMR in capital investment for the upkeep of capacity is even higher than for new construction and reconstruction. This characteristic apparently is associated with a peculiarity in the expenditure of noncentralized capital investment. Thus, Moldavian SSR light-industry enterprises spent about 40 percent of the production development funds to build roads [6, p 16], and this, naturally, leads to an increase in the SMR share.

The following changes in shares of elements of the reproduced structure of capital investment have occurred in industry (percent)*:

Years	Reconstruction	Expansion	Reequipping	Upkeep of capacity
1972.......	13.2	21.0	2.8	13.6
1978.......	6.4	24.4	13.7	10.0

The total share of the four elements of the structure has risen by 4 points during the period being analyzed. However, this concealed profound internal changes of the reproduced structure, mainly growth in the share for reequipping by about 11 points and a reduction for reconstruction by 7 points. Since the SMR share for reequipping is less by far than for reconstruction, this structural shift determined a reduction in the magnitude of SMR in capital investment by 3 points. The other 7 of the 10 points of the reduction that were observed in 1972-1978 were for change of the T-structure within various reproduced elements.

The influence of the reproduced structure of capital investment on its T-structure can be studied more completely if expenditures for making up for withdrawal (elimination) of fixed capital, the accumulation thereof, and change in the amounts of uncompleted construction are singled out. For this purpose, the authors have used the data of the reported balances of fixed capital and statistics on uncompleted construction and uninstalled equipment. Expenditures to make up for withdrawal were computed on the basis of an assumption of the stability of the capacity equivalent of the capital being introduced, which led to an understatement of the magnitude of these expenditures where there was an actual reduction of such an equivalent.

For a certain set of industries let it be required that the effect of the reproduced and branch structures of capital investment on their T-structure be determined. In so doing, there have been determined for every j of the industry ($j = 1, 2, \ldots, J$): its share (d_j) in the capital investment of the aggregate being studied; the share of capital investment for: accumulation of capital (h_{1j}), compensation for its elimination (h_{2j}) and change in amounts of uncompleted construction (h_{3j}); the share of SMR: in the capital accumulated (T_{1j}), in expenditures to make up for its elimination (T_{2j}), and changes in uncompleted construction (T_{3j}). Then the interrelationship of the industry and reproduced structures and T-structures are determined by the following expression:

*Computed according to the data of [9, p 527] and [12, p 369].

$$T_J = \sum_{j=1}^{J} (h_{1j} T_{1j} + h_{2j} T_{2j} + h_{3j} T_{3j} + h_{4j} T_{4j}) d_j,$$

where T_J is the share of the equipment in capital investment for the aggregate of the J industries; h_{4j} is the share of capital investment of the j-th industry which is allocated to it for creating capital for other industries; and T_{4j} is the share of equipment in this capital investment. The function obtained with use of the chain substitution method enabled the contribution of the various factors to the dynamics of the T-structure of capital investment in industry to be evaluated (table 3).

Table 3

The Contribution of Factors in Forming the
T-Structure of Capital Investment in Industry

Factors	1978 vs 1972	1977 vs 1972	1975-1978 vs 1972-1974
Reduction of the share of SMR [construction and installing work], total	-11.0	-8.4	-7.1
Through change in:			
The reproduced structure of capital investment (h_1, h_2 and h_3)	-2.2	-2.0	-0.6
Change of the SMR share in:			
a) Accumulation of fixed capital (T_1)	-1.0	-1.8	-2.1
б) Compensation for elimination of fixed capital (T_2)	-0.2	-0.1	-0.1
B) Change in uncompleted construction (T_3)	-6.1	-2.6	-1.4
Industry structure of capital investment	-1.1	-1.0	-1.0
Other factors	-0.4	-0.9	-1.3

Change in the reproduced structure of capital investment in industry at the end of the 9th and at the start of the 10th five-year plans was marked by a reduction in the share of expenditures for accumulating fixed capital, in which the SMR share was about 50 percent. However, in so doing, a portion of the expenditures that were aimed at compensating for elimination (the share of SMR is about 20 percent) remained as before, and primarily the share of design, survey and other operations and expenditures was increased, which, by and large, was not capital-forming. As a result, shifts in reproduced structure led to a certain reduction in the share of SMR in capital investment of industry (see table 3), without affecting the dynamics of the share for equipment.

The effect from changing the branch structure of capital investment on its T-structure is reflected, as is evident from table 3, in a reduction of the share of SMR by about 1 percentage point. This influence was more considerable with reference to growth in the share of capital investment in the chemical industry and to a reduction thereof for the building-materials industry. Both branches have a higher

share of SMR in capital investment than does industry as a whole. Therefore, growth was observed in the first case, a diminution in the SMR share in industrial capital investment was observed in the second.

The total effect of the reproduced and branch structures of capital investment allows less than half of the total changes in its T-structure to be explained.

The data of table 3 reflect only the balance of the factors. The table does not contain data that explain the dynamics of the T-structure within the reproduced elements themselves of capital investment. Meanwhile, it is a function of more than half of the overall reduction in the share of SMR in the capital investment of industry.

Of the three elements of the reproduced structure of capital investment--accumulation, the replacement of what has been eliminated, and change in uncompleted construction--an especially rapid reduction in the SMR share was observed in change of uncompleted construction. This reduction was more substantial in 1978, when this factor exerted great influence on T-structure dynamics. The share of construction and installing operations in the change of residues of uncompleted construction for industry was reduced from 87 percent in 1972 to 34 percent in 1978. Although this indicator fluctuates strongly by year, on the whole the share of uninstalled equipment in uncompleted construction grows steadily. The fact that the increase in the share of uninstalled equipment in the change in uncompleted construction in 1978 occurred primarily in the chemical industry and in power engineering--industries in which the growth of imported equipment has risen sharply (especially in the chemical industry)--deserves attention.

The T-structure of expenditures for replacing what had been eliminated was more stable in the period being analyzed. Since the share of SMR in the given element of investment expenditure was about 22 percent in 1972, the potential for a later reduction thereof was minimal, because later this would have led to a gradual reduction in the elimination of the passive portion of the capital. The influence of this factor on the T-structure of capital investment of industry, as is evident from table 3, proved to be insignificant.

The influence of reduction in the SMR share in the accumulation of capital, which was associated primarily with change in the structure of the technological methods of production, was much more substantial. Therefore, let us dwell in a little more detail on an analysis of this group of factors.

Of all the large branches of industry, the smallest reduction in the share of SMR in capital investment was observed in power engineering. In 1972-1978, it was about 6 points, 2 of which came during 1978 (table 1), when the volume of imported power equipment rose 1.5-fold. The single-product nature of the output and the absence of a large diversity of technology within the assigned subbranches enables a restricted number of production facilities to be singled out within this branch: thermal electric-power stations (TES's) (their share in 1970 was about half of all capital investment in power engineering, and by 1977, according to our calculations, this amount was reduced down to about 40 percent); the electrical grids (the investment in them during the period analyzed increased, and by 1977, together with the heating grids, it exceeded one-fourth of the industry's capital investment); hydroelectric power stations (GES's) (in 1970 almost a fifth of the capital investment was directed here, but this share in the period being analyzed has been

[illegible] and nuclear electric-power stations (AES's) (the share of this category in [illegible] energy investment is growing rapidly).

Although the power-engineering production facilities named can also be distinguished from each other by technology and scale, they are fairly uniform, so high stability of the T-structure is provided for. Analysis indicates that for each of them the share of equipment in capital investment changed insignificantly, and for AES's and [illegible] and the heating grid it was constant.

From 1970 through 1977 the share of equipment in power-engineering capital investment increased 3.6 points--about as much as the share of SMR was reduced. Reduction of capital investment in the TPS's, where the share of equipment was about 34 percent in 1977 and exceeded the same average indicator for the industry, and growth of investment in nuclear power, in which the share for equipment was 44 percent, exerted the greatest influence on the T-structure of power engineering. Under the influence of the first factor, the share of equipment was reduced by about 2 points, while the second increased it by 4-5 points. Also affecting change in the share of equipment in capital investment in power engineering were: reductions in the share of investment in the development of hydroelectric-power stations, where the share of equipment is very low (11 percent); an overpowering investment in infrastructure technology--electrical and heating grids--where capital investment is, respectively, 29 and 3 percent. An increase in capital investment in other power-engineering production facilities in which the share of equipment is very high (75 percent), exerted an appreciable influence on growth of the share of equipment. Within these production facilities, repair enterprises, which are acquiring a large amount of metalworking equipment, can be singled out, and so can transport. In the aggregate, the enumerated factors explain the predominant part of the reduction in the SMR share and growth in the equipment share in power-engineering capital investment.

In recent years the share of SMR in coal-industry capital investment was reduced by about 9 points. A characteristic feature of the reproduced structure of capital investment in this industry during the 10th Five-Year Plan was spasmodic growth in the share of expenditures for reequipping, a reduction in the share of expenditures for the upkeep of existing capacity, and a redistribution of capital investment between expansion and reconstruction (percent):

The share of SMR in total expenditures for reequipping and upkeep of capacity, and also in capital investment for reconstruction and expansion, changed insignificantly in 1976-1978. When, in so doing, it is considered that the share of each of the two given sums is fairly stable, then it can be supposed that the noted change in reproduced structure is only a statistical fluke--a change in the established procedure for applying capital investment to one form or another of reproduction. Finally, one can be convinced of this conclusion if one compares the dynamics of the reproductive and T-structure (table 1) in this branch: the spasmodic nature of change in 1976-1978 of the first of these was not reflected at all in the smooth dynamics of the second.

Purpose	1975	1976	1977	1978
Reequipping.........	2	16	35	48
Upkeep of capacity..	57	45	28	16
Reconstruction......	3	14	11	8
Expansion...........	13	1	1	1

Which are the factors that determine a gradual reduction in the share of SMR in coal-industry capital investment? One of the causes is the priority growth of

strip coal mining from 27 percent in 1970 to 34 percent in 1977 [10, p 149]. For the stripping method, the share of equipment in capital investment is higher--81 percent--while for underground mining it is 41 percent, the specific share of expenditures on equipment in the budget-estimated cost of constructing the open pits fluctuating within the range of 13 to 47 percent [7, p 7]. Highly productive enterprises, which use flow schemes in which rock is shifted laterally into excavated space and high-capacity equipment is used, incur the greatest expenditures.

Other causes in the reduction of the SMR share are the mechanization and automation of coal-mining operating processes. Thus, coal mining with the use of mechanized supports increased from 30 percent in 1970 to 67 percent in 1977, and the share of the mechanized loading of coal grew during this period from 85 to 95 percent [10, p 104]. Finally, the share of SMR in coal-industry capital investment was reduced because of the increase in expenditures for buying equipment that was not in the budget estimates for the construction project, primarily transport means for developing the production infrastructure in new coal basins.

The share of equipment in capital investment aimed at coal preparation (24 percent) is much less than for coal mining (42 percent). However, the share of interest for coal preparation is only about 3 percent of the investment for mining. Therefore, the development of coal preparation did not appreciably affect the T-structure of capital investment in the coal industry, although in the future this factor will rise because of the need to transport prepared coal from the eastern regions.

Machinebuilding is among the industries with the most dynamic T-structure: during the period 1972-1978 the share of SMR in capital investment was reduced here by 13 points (table 1). The long-term trend of reducing the SMR share in this industry was caused to a great extent by automation and mechanization. For example, because of the introduction of ASU [automated control systems], capital investment in Minpribor [Ministry of Instrument Making, Automation Equipment and Control Systems] rose sharply during the 10th Five-Year Plan for purposes of acquiring computer equipment. The drop in the share of SMR in machinebuilding, especially in recent years, is explained also by the reproduced structure. Thus, expenditures for reequipping existing enterprises of this industry grew from 16 percent in 1976 to 32 percent in 1978. If, in so doing, it is considered that the share of SMR in capital investment for reequipping machinebuilding is about 7 percent, then the overpowering growth of capital investment in reequipping cannot help but effect a reduction in the share of SMR for the industry as a whole. In 1977 and 1978 this influence was determining for machinebuilding. However, not one of these factors can explain the spasmodic nature of the drop in the SMR share in machinebuilding that was observed in 1975. Meanwhile, out of the 13 points of reduction in the share of SMR in the last 6 years, 7 points of the reduction occurred in 1975.

Since machinebuilding has a complicated intraindustry structure, its influence on this leap in T-structure dynamics should be analyzed first of all. Calculations indicate that although the investment in machinebuilding was aimed at developing instrumentmaking, electrical-equipment and chemical machinebuilding and the machine-tool manufacturing industry, and investment in the automotive industry and construction and road machinebuilding were reduced simultaneously, this had practically no effect on T-structure dynamics. This circumstance is explained by the fact that the share of equipment for capital investment in machinebuilding industries did not differ very much among them, and were at about the 50-60 percent level. Therefore, the phenomenon in the dynamics of the T-structure of

Dynamics of the Share of SMR [Construction and Installing Work] in Capital Investment Allocated for New Construction in Machinebuilding.

Key:

-----11 machinebuilding ministries.

———ministries of electrical equipment, instrumentmaking, automation equipment and control systems, and automotive industry.

-·-·-8 machinebuilding ministries.

1. Share of SMR. 2. Years.

capital investment in machinebuilding noted above cannot be the consequence of change in its branch structure.

The spasmodic fall (by 7 points) in the share of construction and installing operations was caused by a sharp change in the T-structure of capital investment of three ministries--Minelektrotekhprom [Ministry of Electrical Equipment Industry], Minpribor and Minavtoprom [Ministry of Automotive Industry]. For the remaining eight ministries, a comparatively smooth reduction in the share of SMR in capital investment was observed. It can be seen in the figure that the 1975 drop in the SMR share for the three named ministries is connected with a reduction in the share of these operations in capital investment for new construction.

An analysis of the registers of titles of construction projects indicated that the sharp reduction in the share of SMR in Minelektrotekhprom was associated with the construction of a large plant for domestic air conditioners, in the budget-estimated cost of which about 31 percent was for SMR, while the average for industry is 55-60 percent. The cause of this difference is that the plant is equipped with costly imported equipment. If the T-structure of capital investment for Minelektrotekhprom is computed after deduction of investment in this plant, then the spasmodic drop in the share of SMR disappears. A similar situation was observed in Minpribor, where a drop in the share of SMR in capital investment was caused by the allocation of substantial capital investment for the construction of a plant for typewriters, which also was outfitted with imported equipment. The cost of this equipment was 25 percent higher than for similar domestic equipment. The cause of the drop in the share of SMR in capital investment for Minavtoprom was the construction of KamAZ [Kama Motor-Vehicle Plant]. Prior to 1975 primarily construction and installing work was being done at this project, while about one-third of the investment allocated for buying equipment was spent. Beginning with 1975, a drawing together of the indicators of fulfillment of the capital investment plan occurred for all of them, including those for SMR. The increase in purchases of equipment for KamAZ during this period was reflected in the T-structure of capital investment for the ministry and for machinebuilding as a whole, although in KamAZ budget estimates the share for SMR was almost the same as for other motor-vehicle enterprises.

The sharp divergence in the dynamics of the T-structure for the period 1970-1977 for various subbranches of machinebuilding merits attention. Thus in 1970 the T-structure for three subbranches of heavy machinebuilding--dieselmaking, metallurgical and power machinebuilding--were about identical. The share of equipment in capital investment was, respectively, 49, 48 and 48 percent. By 1977 it had risen 16 points in dieselmaking and 5 points in metallurgical machinebuilding but had fallen 9 points in power machinebuilding. A similar situation was observed in machine-tool manufacturing. The share of equipment for production facilities had risen by 7 points for forging and pressworking, 13 points for metal-cutting and wood-processing, and 18 points for instrumentmaking, while in 1970 it had been 54-55 percent for all of these three subbranches of machine-tool manufacturing. The difference noted in the T-structure dynamics of subbranches of machinebuilding that are closely related is subject to further study. However, even today, it can be asserted that these differences cannot be completely explained by either pricing factors or technological-structure factors, since the examined groups of subbranches have much in common with each other in technology, level of automation and mechanization, and structure of equipment inventories and purchases, and a relatively homogeneous product mix is characteristic for each of them.

In the chemical industry the share of SMR in capital investment was reduced during 1970-1978 by 15 points, 10 of which relate to the start of the 10th Five-Year Plan (see table 1). Analysis indicated that the influence of the reproduced structure in the industry was appreciable only in 1976, when this factor caused about half of the reduction in the SMR share. Growth in prices and in amounts of imported equipment apparently exerted a decisive influence on SMR dynamics in the chemical industry. It was in 1976-1978 that the most significant drop in the SMR share was observed, and the ratio of imported industrial equipment for the chemical industry (in nonconvertible currency) to capital investment for equipment acquisition was raised from 37 percent in the preceding years to 70-90 percent.*

Thus, in each industry the T-structure of capital investment is affected by a large number of factors. These include: the structure of the production facilities and technology, mechanization and automation processes, development of the production infrastructure, imports of equipment, change in the share of expenditures for reequipping and for other elements of the reproduced structure, and, because of this, change in the ratio of withdrawal and introduction of the active and passive portions of capital. In the aggregate, these factors, together with the branch capital-investment structure and pricing shifts, determine the future dynamics of the T-structure of capital investment at the national economy level.

What are the prospects for change in the T-structure? This question is of great significance in studying development of the complex of machinebuilding branches, since it determines the rigidity of the limits that are superposable on machinebuilding development by future rates of growth in capital investment. The broader range of the increase in the share of equipment and of the corresponding reduction in the share of SMR that is effective for the national economy, the higher the rate of increase in machinebuilding output should be, and the lower the output of construction should be, for the same growth of capital investment.

If one proceeds from the potential for stabilizing the existing ratio of prices for machinebuilding and construction output, at which prices for the output that

*Computed according to the data of [13, p 35].

forms the active and passive portions of capital change approximately proportionally, then as a result this change is not reflected in the T-structure. Since future capital investment in reequipping, upkeep of capacity and other elements of the reproductive structure has not, as a rule, been determined where there are grounds for prospects for developing the branch, and the possible dynamic of the T-structure for each such element lends itself poorly to prediction because of change in ratio of withdrawal of the active and passive portions, a forecast of the T-structure should be oriented to industry information about the desirable service lives of various types of equipment and production buildings and structures. In this case, two extreme variants of the amount of withdrawal (elimination) are possible: an upper one, which follows from the industry's grounds for optimal service life, and a lower one, which is established by means of an integrated balance of equipment and which considers the existence of overall economic restrictions on the amount of withdrawal (elimination). In determining the future possible range of change of T-structure, the authors considered, for example, the following average annual coefficients for the withdrawal of equipment (in percent):

Equipment	1971-1975	Upper	Lower
Metal-cutting machine tools	4	8	7
Metallurgical equipment....	3	8	6
Chemical equipment.........	3	9	6
Mining equipment...........	20	11	11

In accordance with these and other similar factors for withdrawals of equipment, the future range of ratios of eliminations to introductions of capital in industry can change within the 24-35 percent range, yet in 1971-1975 the amount was about 15 percent. Based upon international comparisons, the maximum level of possible future increase in share of equipment in the elimination of fixed capital is defined as 75 percent, while the lower variant of this indicator is adopted at the 1966-1975 level of 61 percent.

In the forecast of the T-structure for industry we took into consideration also an increase in the share of equipment in net capital investment that is channeled to the accumulation of capital, through such factors as saturation of the equipment pool with mechanization and automation equipment and satiation of the infrastructure. Thus, according to our predictions, the share of instruments and automation and computer equipment in total expenditures for equipment will grow in the long terms, as a result of which the share of equipment during the next five-year plan will increase by 2 percentage points and by another 1.3 points in 1986-1990. In connection with preparation of the program for the mechanization of manual labor called for by the CPSU Central Committee and USSR Council of Ministers decree of 12 July 1979, "On the Improvement of Planning and Strengthening of the Influence of the Economic Mechanism on Increasing Production Efficiency and Work Quality," in the future the mechanization factor will play an ever-increasing role, which should also affect the increase in the share of equipment in capital investment.

Aside from this, the increase in share of investment in machinebuilding (from 20 to 25 percent) and the reduction in amounts of uncompleted construction in industry also was considered.

All these factors defined to the maximum the permissible future limit of growth in the share of equipment in capital investment in industry at 12 points. In this case, about half of the growth is connected with an acceleration of the withdrawal of fixed capital (particularly its active portion), about 40 percent with an

increase in the share of equipment in the accumulation of fixed capital, and the remaining 10 percent is for a reduction in the amounts of uncompleted construction and for the accelerated development of machinebuilding.

In computing the ranges of change of the future T-structure of capital investment in the /national economy [in italics]/, the authors considered, apart from the factors enumerated above, changes in the branch structure of investment (growth of the share of capital investment in industry, transport and communications, with a simultaneous reduction in the share of rural construction and housing construction) and a reduction of the share of equipment in capital investment in agriculture through an increase in the service lives of agricultural equipment and accelerated development of the supply and equipment base of animal husbandry. In so doing, the upper variant of the desirable increase in the share of equipment in all capital investment in the national economy was about 7 points.

The forecast of the T-structure of capital investment that was obtained permits the existence of such socio-economic restrictions as pace of economic growth, norms for accumulation, and others to be considered in computing the pace of growth and the structure of machinebuilding output.

The nature of the effect of socio-economic restrictions on capital investment volume can be understood on the basis of the following hypothetical example. Let the rate of growth in use of national income in the period being forecast be 3 percent per year [8]. Where the norms for accumulation and the share of capital investment in the accumulation fund are unchanged, the future rate of growth of capital investment also will be 3 percent. Based upon this, and taking into account an economically advantageous increase in the replacement coefficient for some types of equipment, and a reduction of it through growth in longevity and reliability for other types, and also taking into account growth of expenditures for replacing withdrawn passive fixed capital (buildings, structures and transfer installations), a determination is made, on the basis of a self-contained study of the technological structure of the capital investment, that in the forthcoming decade it will be desirable to increase the share of equipment in capital investment to 7 points. Then, using the basic magnitude of capital investment in equipment and construction and installing work as a springboard, it can be estimated that the average annual pace of growth of investment deliveries of equipment will not exceed 4 percent. If, in doing so, one proceeds from the hypothesis of the elimination of a negative foreign-trade balance for machinebuilding output and an outpacing rate of growth of equipment turnover within machinebuilding as a result of the development of specialization and cooperative arrangements, then the future rate of growth of the production of equipment will be somewhat higher, let's say, 5 percent per year.

As the computations indicate, in the future the T-structure will be more dynamic than in past years. However, the widespread point of view that the effective range of increase in the share of equipment in capital investment is extremely broad and the desirable proportion between machinebuilding and construction is very flexible should be recognized as erroneous.

A further rise in the validity level of T-structure prognoses presupposes an optimization of its calculation. In our view, the solution of the given problem is presented as a synthesis of the accomplishment of more specific tasks: optimization of the processes of updating and eliminating fixed capital and of the structure of the technologies, [illegible] the branches and subbranches, and the amounts of

uncompleted construction. Optimized variants of the T-structure can be computed on the basis of their solution by means of the methodology examined above.

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FACTORS THAT DETERMINE CONSTRUCTION TIME FOR MACHINEBUILDING STUDIED

Moscow IZVESTIYA AKADEMII NAUK SSSR: SERIYA EKONOMICHESKAYA in Russian No 2, Mar-Apr 81 (signed to press 26 Mar 81) pp 78-92

[Article by G. B. Sychev: "The Time Factor in Producing the Tools of Labor"]

[Text] The article examines the problem of cutting the time taken to create new types of machinery and equipment, particularly in reducing periods for erecting production capacity for the output of progressive tools of labor. The factors that determine the duration of construction in the industries that specialize in producing the tools of labor are analyzed. A quantitative evaluation of the effect of these factors is given and ways to reduce the construction lag in machinebuilding branches are outlined. Computations are made in the example of 12 branches of machinebuilding.

Distinctive features of the economics of developed socialism are an intensification of social production and a growth in its effectiveness. Rapid updating and qualitative improvement of the production apparatus of branches of the national economy, based upon use of the tools of labor that incorporate the latest achievements of scientific and technical progress is the basis of the intensification process. Because of this, the flexibility of industries that specialize in producing the tools of labor and their capability to react quickly to changes in national economic requirements for new types of equipment are acquiring major significance.

The chief factor in increasing flexibility in the production of the tools of labor is the time factor, that is, reduction of the period from the creation of models of new machines and equipment to the start of their production. The most important area for reducing this period is reduction in the time taken to create production capacity for producing progressive tools of labor by means of reequipping reconstruction, expansion and new construction. In this connection, as Comrade N. A. Tikhonov, Chairman of the USSR Council of Ministers, observed in the report to the 26th CPSU Congress, it is necessary "...to design and build with good quality, effectively and rapidly, and to see to it that each facility is introduced by the established deadline and is modern in all respects" [1].

The topic of this article is an analysis of the factors that determine the duration of construction in branches of machinebuilding, and also an evaluation of a factor-by-factor reduction of the construction lag in machinebuilding. The analysis was

conducted in the example of 12 branches: power machinebuilding, heavy and transport machinebuilding, the electrical-equipment industry, chemical and petroleum machinebuilding, machine-tool manufacturing, interindustry production operations, instrumentmaking, the automotive industry, tractor and agricultural machinebuilding, machinebuilding for animal husbandry and feed production, construction, road and municipal machinebuilding, and machinebuilding for light industry and the food industry. The nature of the data used enabled the influence of a number of factors that operate in the sphere of planning and financing of capital construction to be studied. They were: magnitude of the construction-start reserve, the reproduced and technological structure of capital investment, the sizes of the enterprises under construction, the specifics of the capacity being erected, and the conformity of the actually allocated capital investment to the standard amount thereof. Of the factors that operate in the sphere of work performance, the influence of the construction method--contract and in-house construction--at the facilities being erected has been considered.

Because of the difficulty in singling out startup complexes at many construction projects, the construction periods cited in this work characterize the full length of the erection of the project, not counting intermediate introductions of production capacity. Because of this, construction time per unit of growth of capacity (specific construction time) is also examined. One million rubles has been adopted as the unit, since the cost indicator will enable comparison of the times for creating qualitatively different items of capacity.

Characteristics of Construction Time in the Machinebuilding Branches. At present the time taken to erect production capacity for producing equipment is substantial [7]. However, the average construction time varies considerably by individual branch of machinebuilding. Capacity is being erected most rapidly in machinebuilding for animal husbandry and feed production, machinebuilding for light industry and the food industry, and instrumentmaking, and it is longest of all in tractor and agricultural machinebuilding, the electrical-equipment industry, and machine-tool manufacturing. With such a substantial length of time for construction, which exceeds the bounds of the average planning period, and the existing periods for equipment obsolescence of 7-8 years, the probability that the capacity will age while it is still being built is great. Taking into account the time spent creating models of new machines, designing enterprises, and assimilating the capacity introduced, the "science and production" cycle for advanced equipment that will satisfy new demands by the national economy can be stretched out over a lengthy period. A reduction of construction time is the most important reserve for reducing this cycle.

High standard deviations from the average period testify to the fact that in machinebuilding branches, despite the substantial average construction time, many construction projects are being completed in much less time, some within the framework of one five-year plan. This is confirmed by a histogram distribution of construction projects for machinebuilding according to construction time. The significance of the average, median and mode of distribution indicate the presence of factors that affect the magnitude of the construction lag in opposite directions.

The inhomogeneity of the aggregate being studied in size of enterprise, nature of the output produced and other parameters leads to a great difference in evaluations of average construction time for branches that are obtained by formulas for the arithmetic average, the average weighted by budget-estimated cost, and the average

harmonic weighted by budget-estimated cost. However, interbranch ratios are practically unchanged in this case.

It should be noted that evaluations of average construction times vary considerably as a function of the choice of facilities to be measured, which is dictated by the form of the reporting and planning data. The average time for construction of an enterprise, which can be determined from the list of construction project titles, gives an overstated evaluation of the construction lag, since it does not consider intermediate introductions of capacity. A calculation of the average time based upon the construction periods for facilities that are part of construction projects understates evaluations of the period from the start of the investment until output is produced: the erection within standard periods of facilities that are directly connected with the output of a final product (for example, cast-iron departments) do not always provide for timely introduction of the whole complex for producing output. Evaluations of average construction times for startup complexes and phases do not fully reflect the time for erecting auxiliary servicing and subsidiary production facilities, which strongly influence the final indicators of production facilities.

Let us examine the factors that determine construction time in machinebuilding. Let us add that this work does not analyze the direct effect of such economico-organizational and technological factors as the quality of the design, the organization of material and labor resources at the construction projects, and many others. Their influence does not lend itself yet to quantitative measurement. Obviously, there is no necessity or possibility for considering the effect of these factors at branch-level management and planning.

The Influence of the Sizes of the Construction-Start Reserve on Construction Time. The amounts of developed construction and the correlations thereof with the capital investment resources influence considerably the periods for erecting production capacity. This necessitates the forming of rational amounts of a construction-start reserve with respect to capacity and to capital investment. In considering the contradictions that exist in the economic literature between the definitions of the construction-start reserve as to capacity and the construction-start reserve as to capital investment [3], we explain that in this article the construction-start reserve is understood to mean the indicator that characterizes the scale of accomplished construction.

An indicator that reflects the time spent in forming uncompleted construction was used to describe the construction-start reserve in machinebuilding branches, along with the widely used indicators for uncompleted construction and for readiness of the construction-start reserve. It was computed as the ratio of the amount of uncompleted construction on a definite date to the average annual capital investment that had been assimilated on that date [4]. An indicator of the spreadout of capital investment "by previously adopted planning and design decisions" is very expressive [5], and it characterizes the expected period of completion of the developed construction-start reserve within the existing ceiling on capital investment. It is calculated as the ratio of the budget-estimated cost of the construction start reserve (not counting uncompleted construction) to annual capital investment. The given indicator is also called the expected, upcoming period for completion of the construction.

Setting norms for all four indicators and not just for the first two [6] would enable the amounts of accomplished construction to be correlated with the existing resources.

calculations point to a substantial differentiation in the amounts, structure and flexibility of the construction-start reserve for the 12 branches of machinebuilding. However, on the whole, one can speak about the high sluggishness of accomplished construction in machinebuilding, which will prevent acceleration of the introduction of capacity in the 1980's and the forming of new construction-start capacity for the output of progressive tools of labor.

Given the arbitrariness of average branch indicators, the amount of uncompleted construction was 150 percent with regard to annual capital investment [9], which is almost double the average indicator for uncompleted construction in machinebuilding, computed on the basis of [6]. Nevertheless, the above-norm amounts of uncompleted construction (relative to annual capital investment) are inadequate in comparison with the cost of the construction-start reserve because of unjustifiably large amounts of the latter. The given proportion, which is characterized by the indicator of readiness of the construction-start reserve, is below standard 1.73-fold [6].

But although the amounts of uncompleted construction in machine-tool manufacturing and chemical machinebuilding exceed two annual plans for capital investment, in machinebuilding for animal husbandry and feed production, and also in power machinebuilding, uncompleted construction is less than the annual amount of investment.

The greatest age (up to 2.5 years) for uncompleted construction in machinebuilding is in light industry and the food industry and agricultural machinebuilding, while the lowest (less than 1.5 years) is in machinebuilding for animal husbandry and feed production, the automotive industry, and instrumentmaking.

The degree of spreadout of capital investment in machinebuilding (or the forthcoming construction time), which takes up more than one and a half five-year plans, cannot be considered satisfactory. The requirements of high flexibility for the production of the tools of labor lead to a need to introduce capacity 3-4 years after construction starts or, as a maximum, within the framework of one five-year plan. However, as analysis indicates, the spreadout of capital investment by branch of machinebuilding, where there are capital investment resources for the full completion of all construction projects started, necessitate periods that go beyond the limits of a five-year plan [9].

The construction-start reserve in instrumentmaking--the sole branch that can maneuver within the framework of one five-year plan--is more flexible. This is achieved by the fact that the speed of materialization of the construction-start reserve for industrumentmaking in fixed capital and uncompleted construction is considerably higher (2-fold to 2.5-fold) than, for example, in machine-tool manufacturing or heavy and transport machinebuilding. As a result, instrumentmaking has the best indicators for technical and economic level of production in machinebuilding: the best coefficients for the updating and withdrawal of capital, the lowest age of products produced, the largest share of output of products of highest quality category, and so on [7].

An analysis of the distribution of machinebuilding projects by expected periods for completion of construction indicate that there are major reserves in machinebuilding for reducing the time required for full introduction of capacity whose construction has started: 37 percent of all construction projects are completed in

little more than 3 years, and 60 percent within one five-year plan. Consequently, the prerequisites exist for speeded-up solution of the tasks of increasing the flexibility of production of the tools of labor, as decreed by the 26th CPSU Congress [1]. The best Soviet and foreign experience in organizing production for new types of machines and equipment within a few years or even months testifies to the potential of machinebuilding as the most flexible branch of the national economy.

The main cause of the high sluggishness of the construction-start reserve for producing the tools of labor and of the lengthiness of the periods for forthcoming introductions of capacity is the substantial noncorrespondence of the amounts of the construction-start reserve (of a construction program under way) with the existing capital investment resources. Calculations indicate that, in order to complete construction within the planned periods of the construction-start reserve that has been created for today in machinebuilding, investment must be increased by 40 percent, which is impossible because of the restriction of capital investment by the framework of the final product. A realistic area for reducing the spreadout of machinebuilding capital investment is a corresponding reduction in the cost of the construction-start reserve. This can be done by reducing the number of newly started construction projects and by reducing the number of facilities being built simultaneously, for which purpose it is necessary to develop a system of priorities for the sequence of construction of facilities already started. "It is necessary to implement more energetically the directives of the party Central Committee and the instruction of Leonid Il'ich Brezhnev about the decisive struggle against the dispersion of capital investment, about the concentration thereof at the most important segments of industrial and agricultural production and of projects due for startup, and about the reduction of construction periods for new facilities," said N. A. Tikhonov in his report at the 26th CPSU Congress [1].

The noncorrespondence between the capacity of construction and installing organizations that are doing the construction work and the work front that has been promoted for the work is a manifestation of the disproportions between capital investment ceilings and the amounts of accomplished construction. Analysis indicates that for a number of general contracting organizations that are doing construction work for machinebuilding, the amount of actually assimilated construction and installing work consists of less than two-thirds of the annual amounts of work necessary for the completion of construction within the planned periods.

The Influence of the Reproduced and Technological Structure of Capital Investment on the Duration of Construction.

An analysis of the interdependence of the reproduced and the technological structures of capital investments and their influence on the duration of construction that has been made for a very representative sample will enable the effectiveness of various types of reproduction of capital in machinebuilding to be compared.

At present about 60 percent of capital investment goes to expansion and the reconstruction of existing fixed capital [9], which, as a whole, meets the goal of intensification of machinebuilding production. However, the share of in-house construction is not great and requires a considerable increase.

The advantage of intensive forms of reproduction of fixed capital consists in the potential for obtaining growth in production capacity with a considerably lesser

amount of construction and installing work and a larger share of the expenditures for equipment. In this case, the speed of the investment process is raised substantially. Studies indicate that today, when conducting expansion and, especially, reconstruction, the advantages that they incorporate are not completely realized.

The considerably lesser cost (1.53-fold less) per unit of capacity (specific capital investment) testifies to the greater effectiveness of reconstruction in machinebuilding in comparison with new construction [9]. However, the analysis of the technological structure of capital investment in reconstruction that was conducted for all branches of machinebuilding indicates that a major portion of investment (almost 60 percent) goes for construction and installing work, its share being much higher than the share of such operations in other types of reproduction of capital. In 6 of the 12 branches of machinebuilding, capital construction plans include facilities that are being reconstructed that have a technological structure of capital investment that is worse than for new construction. In other words, in the production of the tools of labor, reconstruction still has been directed to a great extent toward reorganizing, making new layouts, and modernizing the passive portion of the fixed capital, and not energetically enough toward replacing it with new and progressive equipment.

Because of the greater share of construction and installing work during reconstruction, labor intensiveness and the time taken to create a unit of production capacity increase. So the reconstruction of a unit of capacity is 2-fold to 3-fold longer than for expansion or for new construction. Expansion also is inferior to new construction in the time taken to create capacity. The data of table 1 show that the more progressive types of reproduction of capital for almost all branches of machinebuilding are inferior to new construction in the time taken to create a unit of capacity. It should be noted that the lack of precise criteria in assigning construction that is under way to one of the forms of reproduction in the planning and reporting data impedes an objective comparison of the effectiveness of reconstruction, expansion and new construction.

Table 1

The Effect of the Nature of Construction on the Time Taken to Create 1 Million Rubles' Worth of Production Capacity, Years (the figures are tentative)

Branch	Nature of construction			Branch	Nature of construction		
	New	Expansion	Reconstruction		New	Expansion	Reconstruction
1	0.07	0.11	0.23	8	0.07	0.14	--
2	0.17	0.21	0.30	9	0.09	0.15	--
3	0.17	0.29	0.45	10	0.19	0.11	0.28
4	0.31	0.42	0.36	11	0.08	0.32	0.27
5	0.22	0.43	1.23	12	0.23	0.42	--
6	0.40	0.59	1.32	Machinebuilding,			
7	0.22	0.29	0.67	overall	0.12	0.22	0.41

A rise in the share of reconstruction and reequipping as one of the ways to intensify machinebuilding during the 11th Five-Year Plan required improvement of the given forms of the reproduction of capital, especially with regard to reducing their absolute and relative duration. Among the most important measures for shortening reconstruction periods are: the creation of specialized construction and installing organizations that are provided with special equipment for doing reconstruction work; the forming of reserve capacity at enterprises that will enable a

part of the capacity to be stopped painlessly while the work is being done; and the execution of a set of measures for economic incentives for reconstruction.

A correlation analysis that has been conducted for all machinebuilding branches has confirmed the naturalness of an increase in construction time per unit of production capacity where there is an increase in the share of construction and installing work in the capital investment. Figure 1 shows curves of this function for a number of industries. Elasticities of the specific construction time versus the share of construction and installing work in capital investment, with a reduction of the latter from 55 to 50 percent, are also cited. There are especially great reserves for reducing construction time by improving the technological structure in power machinebuilding, interindustry production, heavy and transport machinebuilding, and machinebuilding for light industry and the food industry (the data are cited for branches for which statistically significant functions were obtained).

Elasticity of Specific Time Periods vs the Share of Construction and Installing Work in Capital Investment, %

Branch	Percent
1	-2.81
2	-1.60
3	-1.03
5	-1.69
6	-2.50
7	-0.89
12	-1.44

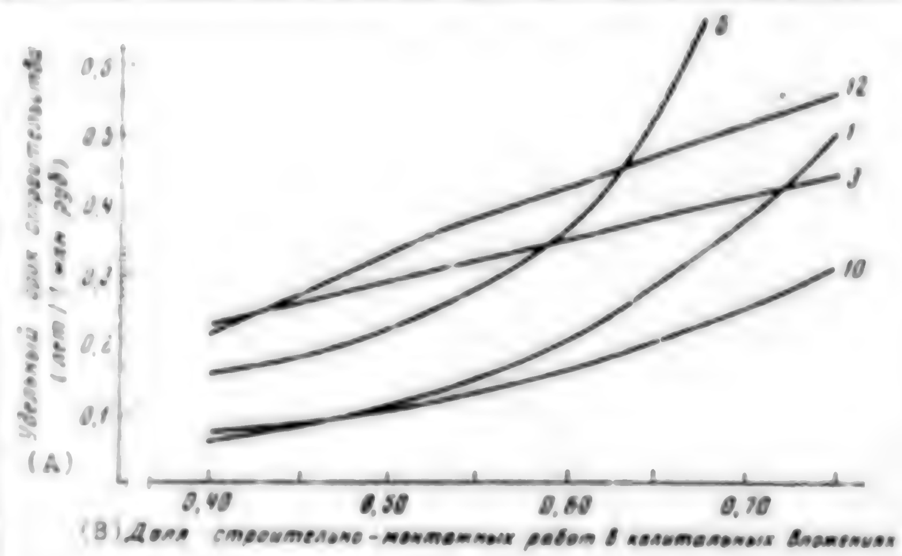


Figure 1. Specific Construction Time as a Function of the Technological Structure of Capital Investment.

Key:

A. Specific construction time (years/1 million rubles).
B. Share of construction and installing work in capital investment.

The Influence of the Sizes of Enterprises Under Construction on Construction Time. As studies show, construction time for enterprises being built varies greatly with their size, productive capacity and budget-estimated cost. Differences in the products produced and in levels of concentration and specialization of production lead to a considerable difference in the sizes of enterprises being erected in the machinebuilding branches. While construction projects that cost less than 25 million rubles comprise 28.5 percent of the cost of the construction being conducted in machine-tool manufacturing, in machinebuilding for light industry and the food industry the figure is 49.1 percent, and in instrumentmaking 74.5 percent. The existence in some branches of a large number of big construction projects that cost 100-500 million rubles has been engendered not so much by high concentration of production and orientation to large-series production of the future enterprises as

by inadequate specialization thereof and by a striving to create plants with a closed cycle, which leads to the appearance thereof of a large number of poorly productive auxiliary and service-type production facilities. The comparatively short construction time in instrumentmaking and the flexibility of its construction-start reserve has been determined to a great extent by an orientation to the creation of a highly cooperative network of narrowly specialized enterprises. Rejection of the construction of giant plants of broad profile will enable construction time to be shortened and will facilitate work on reconstruction and reequipping. A study of specific construction time as a function of the size of the enterprise indicates that in all industries specific times are reduced with increase in capacity only up to certain limits, after which they practically do not change with further growth in capacity (figure 2). Later growth in the capacity of enterprises where the operating pace of construction organizations is unchanged stimulates directly proportional growth in absolute construction time. Thus, a grouping of construction projects for machine-tool manufacturing by construction time indicates that enterprises with a capacity of more than 75 million rubles take longer to build; at the same time a unit of capacity is built more rapidly.

The level of organization and concentration of resources at construction projects exerts a decisive influence on construction time. When the level thereof is least, it takes just as long to build the smallest of above-ceiling construction projects in machine-tool manufacturing as it does the largest, and, per unit of capacity, it takes about a year longer. Thus it is impossible to draw a conclusion about building only small enterprises on the basis of purely arithmetical calculations.

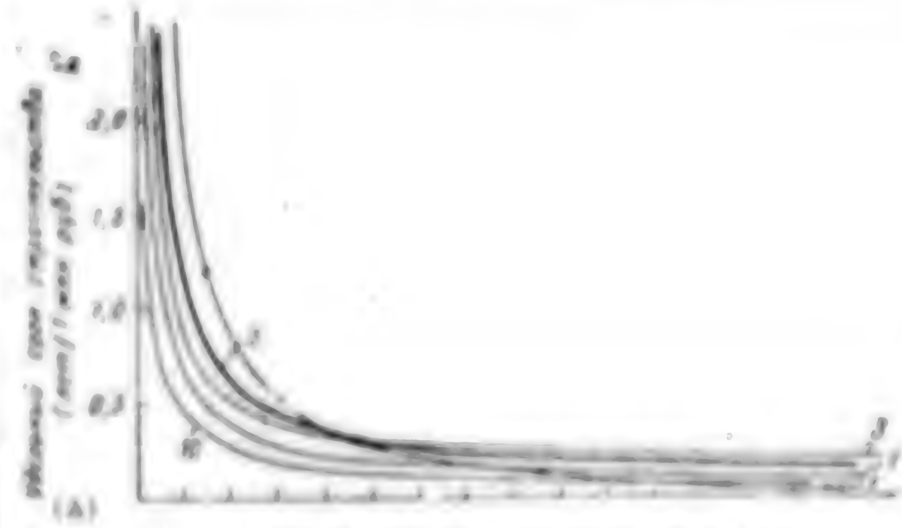


Figure 2. Specific Construction Time as a Function of the Productive Capacity of Enterprises.

Key:

A. Specific construction time (years/ 1 million rubles).
B. Productive capacity, millions of rubles.

Nevertheless, calculations indicate that the predominance of large or small construction projects in an industry leads to a correspondingly higher or lower average construction time for the industry. The exception, which is interbranch production (minimal average enterprise sizes and high average construction times), only confirms the paramount influence that is exerted at times on construction time by a balancing of construction with the capacities of construction organizations and by the level of organization of material and human resources at the construction projects. Thus the construction of the specially built giant plants (AvtoVAZ [Automotive Production Association of the Volga Motor-Vehicle Plant], KamAZ [Kama Motor-Vehicle Plant], Atommash and

others, which enable great shifts to be made in the branch and regional structures of production), were completed, as a rule, within the planned periods, thanks to the great concentration of resources. During construction of enterprises of ordinary priority, the balancing of construction programs with the capacity of construction and installing organizations is acquiring decisive significance. In machinebuilding there is not enough capacity at present for the entire construction and installing work volume that is necessary annually for completion of construction projects within the planned periods. Under these circumstances, given the traditional evaluation of the activity of construction organizations, the builders give preference to facilities that provide a broad front for expensive construction and installing work, and, in so doing, the introduction of capacity and of capital is not the mission of the organization. In the final analysis:

The sizes of enterprises are determined primarily on the bases of the economic policy for siting productive forces and of strict technical and economic feasibility, and, in so doing, the optimum size of an enterprise is that one at which minimum capital and operating and current expenditures are achieved per unit of output [8]. However, the data computed must also be justified in accordance with construction-time criteria, based not just on construction time norms but also on the actual construction periods for enterprises of various capacities;

The prerequisite for timely completion of a construction project that is included in the register of construction project titles is a rigorous balancing of the cost of the construction-start reserve with the ceiling of the branch's capital investment (of accomplished construction with the capacities of the construction and installing organizations); and

Timely completion of the construction of machinebuilding enterprises should help in converting to the new system of evaluating the activity of construction organizations and to economic incentives granted them as the result of carrying out tasks for introducing production capacity and facilities into operation [2].

The Influence of the Specifics of Production Capacity on Construction Time. Differences in the output produced cannot help but affect the speed of creation of productive capacity in branches of industry. It is obvious that the tools of labor, which are characterized by purpose, technical complexity, quality, and technology, require different expenditures for creating the corresponding capacity, and from this arise differences in capital intensiveness per unit of capacity, both within a single branch and among branches. Greater capital intensiveness requires longer creation times (Figure 9). This function is statistically significant for 9 of the 12 branches. We will cite the elasticity of specific construction time versus the cost per unit of capacity (specific capital investment) for 9 branches of machinebuilding where the cost per unit of capacity varies from 90 kopecks to 1 ruble).

Construction time is more sensitive to change in the cost of the capacity in the electrical-equipment industry, tractor and agricultural machinebuilding, and construction, road and municipal machinebuilding, so in these branches there are substantial reserves for reducing the cost of the production facilities being erected.

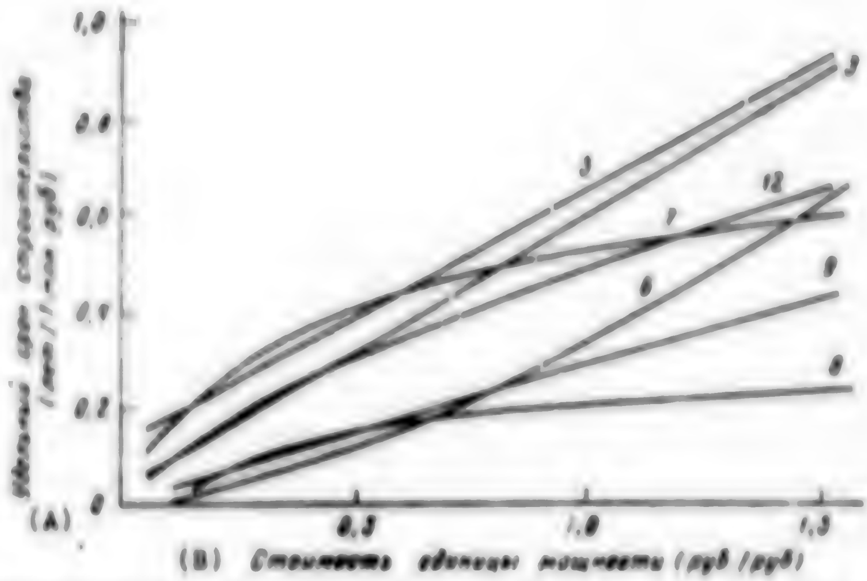
Elasticity of Specific Construction Time vs Cost Per Unit of Capacity, %

Nr Branch	Percent
3	0.93
5	0.77
6	0.79
7	0.83
8	0.32
9	0.93
10	0.96
11	0.96
12	0.68

Figure 3. Specific Construction Time as a Function of the Cost of a Unit of Capacity.

Key:

A. Specific construction time (years/1 million rubles).
B. Cost per unit of capacity (rubles per ruble).



The Effect on Construction Time of the Conformity of the Capital Investment Actually Allocated to the Standardized Amount Thereof. The financing of capital construction in amounts that permit construction to be completed within the standard (or planned) time periods is a part of the problem of the correspondence of accomplished construction to the branch's capital-investment ceiling. The ratio of the capital investment actually assimilated to the investment that should be executed in accordance with the standards can be viewed as an indicator that characterizes the level of concentration of capital investment at facilities under construction and the intensiveness of investment in the construction work being done.

The concentration of capital investment, as research indicates, is not the strongest factor with regard to effect on construction time (estimated per unit of capacity). The allocation of capital investment in the full amount does not do away completely with the problems of reducing construction time to the standards by virtue of the action of a multitude of other factors (the organization of material and labor resources, for example).

For all branches, except the automotive industry, the reduction in time spent in creating a unit of capacity with a higher level of concentration of capital investment is expressed clearly (figure 4). Research has been conducted by correlation analysis (the results are shown in table 2). The connection obtained for the eighth branch, although it is weak and conflicting with economic thought (table 2, group 1), testifies to the strong effect of other factors on specific time. In order to clarify the effect of the concentration factor, all the construction projects in each branch were divided into two groups, depending upon the construction time: those erected in 10 or more years, and those erected in less than 10 years. Within each group, the dependence of specific time on that same factor (table 2, groups 2 and 3) was studied. The results indicated that in most branches, even smaller absolute construction times predetermine the substantial influence of capital investment intensity on construction time. The weak tie of the given factor with specific construction times for enterprises with lengthy absolute times was caused by the effect of such factors as the low level of organization of resources at these construction projects, review of designs and budget estimates, and other factors.

Figure 4. Specific Construction Time as a Function of the Level of Concentration of Capital Investment.

Key:

A. Specific construction time (years/1 million rubles).
B. Level of concentration of capital investment.

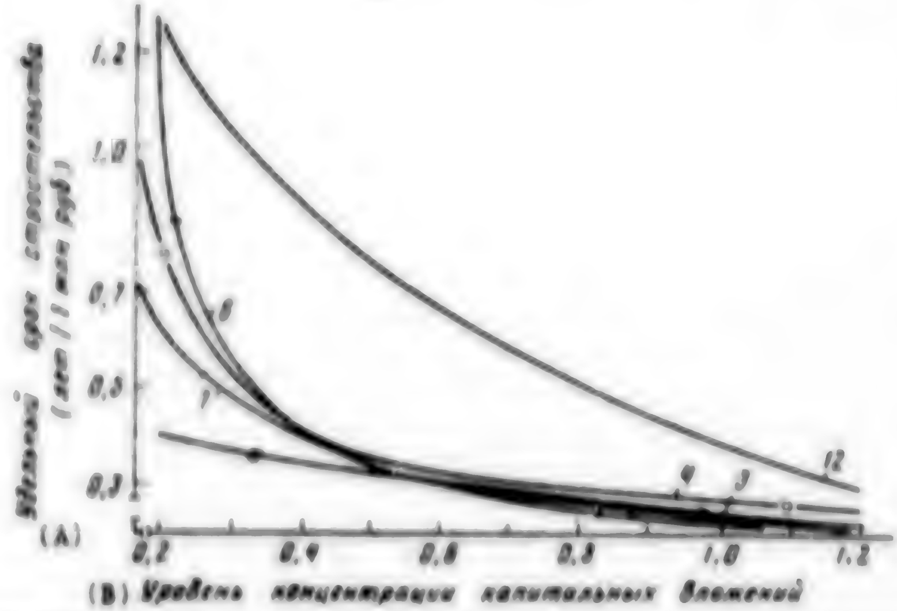


Table 2

The Correlational Dependence of Specific Periods on the Level of Concentration of Capital Investment for Facilities That Have Different Construction Times

Branches	All construction projects	Including: Those built in 10 yrs or more	Including: Those built in less than 10 yrs	Intensification (+) or weakening (-) of the factor $(\frac{gr\ 3}{gr\ 2} - 1) \cdot 100$ percent
A	1	2	3	4
1	-0.39	-0.09	-0.96	+967
2	-0.29	-0.24	-0.69	+188
3	-0.32	-0.21	-0.35	+67
5	-0.39	-0.23	-0.15	-35
6	-0.42	-0.13	-0.36	+177
7	-0.51	-0.28	-0.57	+104
8	+0.06	+0.10	-0.43	+530
9	-0.28	-0.26	-0.73	+181
11	-0.45	-0.17	-0.26	+153
12	-0.47	-0.54	-0.48	-11

An analysis of the elasticity of specific construction time versus the level of concentration as the latter increases from 0.5 to 1.0 indicated that construction time in machine building for light industry and the food industry, power m[illegible]inebuilding, and instrument-making are more sensitive to growth in concentration of capital investment.

Elasticity of Specific Construction Time vs Level of Concentration of Capital Investment, %

Branch	Percent
1	-0.43
2	-0.27
3	-0.19
5	-0.26
6	-0.34
7	-0.36
9	-0.17
11	-0.36
12	-0.4[illegible]

The Effect of the Method of Doing the Work on Construction Time. The method of carrying out operations at facilities--in-house, contracting, or a combining of them--is defined in registers of construction project titles. A comparison of their effectiveness indicates that at present the in-house method of construction is inferior to contracting. Thus, for machinebuilding as a whole, it takes 3.2-fold longer to build a unit of capacity by the in-house method than by contracting [9], and the absolute construction time by the in-house method exceeds the contract construction time. It should be noted that, for the aggregate being studied, the construction of a unit of capacity at facilities that are erected completely by the in-house method costs 2.4 percent less than for facilities erected completely by contracting and is 19.0 percent cheaper than for facilities erected by contracting organizations in which the in-house method is involved.

Analysis has indicated that facilities with a high share of construction work, which is basically characteristic of reconstruction, are being erected by the in-house method. The specific conditions for reconstruction (lack of work space and the need for special equipment) restricts the use of ordinary construction equipment and leads to a growth in costs and the wide use of manual labor. Since the existing pricing for such operations does not always completely compensate the contracting organizations for the increased expenditures for mechanisms and wages, the construction organizations are unwilling to undertake the reconstruction of enterprises, and they do not try to complete them quickly and on time. Therefore, the industrial enterprises themselves have to do this work, without having at their disposal an adequate materials base and cadres of their own construction workers with the needed skills. This stretches out the construction time per unit of production capacity when the work is done by their own people (that is, by the in-house method). A basic advantage of this method--the striving to complete construction of the facilities more rapidly--can be developed, as was noted in the CPSU Central Committee and USSR Council of Ministers decree of 12 July 1979 [2], by creating within industrial and production associations specialized construction and installing organizations to work on the reequipping and rebuilding of existing enterprises.

It is possible to construct for the branches being analyzed regression equations that reflect specific construction time (Y) as a function of the cost of a unit of capacity (X_1), the production capacity of the enterprise being built (X_2), the technological structure of the capital investment (the share of construction and installing work (X_3)), and the level of concentration of capital investment (X_4). The equations with the best characteristics are shown in table 3.

The analysis of construction time and of the factors that govern it that was conducted in the machinebuilding branches permit the following conclusions to be drawn.

1. The time now taken to erect production capacity for output of the tools of labor is very substantial [7]. Taking into account the time spent creating models of the new machines, designing enterprises and assimilating the capacity after the completion of construction, the cycle of creating new tools for labor becomes extremely protracted, hampering solution of the problem of putting the achievements of scientific and technical progress into use in new construction.

Table 3

Regression Equations of Specific Construction Time as a Function of the Cost per Unit of Capacity, the Enterprise's Productive Capacity, the Technological Structure of the Capital Investment, and the Level of Its Concentration

[illegible] (1)	[illegible] (2)	[illegible] (3)	[illegible] (4)
1	$\ln Y = -3{,}2271 + 0{,}2707\,X_1 - 0{,}0063\,X_2 +$ (0,3312) (0,0534) (0,0006) $+ 1{,}3327\,X_3 - 0{,}8461 \ln X_4$ (1,0918) (0,1856)	0,20	0,90
3.	$\ln Y = -0{,}7762 + 0{,}3610\,X_1 - 0{,}0120\,X_2 +$ (0,2432) (0,0718) (0,0008) $+ 1{,}1713\,X_3 - 1{,}2266\,X_4$ (0,2870) (0,0957)	0,37	0,75
7.	$\ln Y = -1{,}2648 + 0{,}2430 \ln X_1 -$ (0,3061) (0,1293) (0,0020) $- 0{,}0129\,X_2 + 0{,}5967\,X_3 - 0{,}9166\,X_4$ (0,3401) (0,0802)	0,26	0,86
8.	$\ln Y = 1{,}0233 - \frac{0{,}1229}{X_1} - 0{,}9512 \ln X_2 +$ (0,0987) (0,0128) (0,0136) $+ 0{,}0116\,X_3 + \frac{0{,}4167}{X_4}$ (0,0153) (0,1222)	0,09	0,98
12.	$\ln Y = -3{,}3620 + 0{,}2498\,X_1 + \frac{12{,}2435}{X_2} +$ (0,3022) (0,1249) (0,9926) $+ 1{,}3043\,X_3 + \frac{0{,}4335}{X_4}$ (0,0415) (0,4230)	0,34	0,90

Key:

1. Branches.
2. Regression equations with the parameters and their standard errors.
3. Coefficient of variation.
4. Coefficient of determination.

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2. The low flexibility of the construction-start reserve for machinebuilding that links capital investment to one and a half five-year plans ahead is a factor that essentially restricts the speed of structural shifts in producing the tools of labor. A main area for reducing the spreadout of machinebuilding resources in time, as a prerequisite for increasing the flexibility of the production of the tools of labor, is a reduction in the cost of the existing construction-start reserve. A 12-percent reduction in its cost will reduce the spreadout of the branch's capital investment to 5 years.

3. Expansion and reconstruction as types of the reproduction of fixed capital are inferior in their absolute and relative duration to new construction; this greatly reduces their effectiveness. The basic cause of this is a technological structure of capital investment during expansion and, especially, during reconstruction that is worse in comparison with new construction, as well as a lesser concentration of resources. Improvement of the existing technological structure--a reduction in the share of construction and installing work down to 50 percent, for

example--will stimulate a reduction in specific periods, from 25.1 percent in interindustry production facilities to 8.0 percent in the electrical-equipment industry.

4. The growing amounts of work on reconstruction and reequipping make it desirable to create within the frameworks of industrial enterprises (or associations) specialized construction and installing organizations for performing these operations; this will enable the periods for conducting them to be shortened and quality to be raised. The existing forms of the in-house method of construction are poorly effective and consume much time.

5. In order to speed up reconstruction and technical reequipping under presently existing conditions for operation, it is necessary to create reserve capacity that will enable a portion of the capacity being updated to be stopped without damage to the plan tasks. This reserve capacity will raise the flexibility of the equipment production structure when new types of output are being mastered.

6. Additional validation of the optimal sizes of enterprises being erected, in accordance with the criterion of the time taken to build them, is necessary: the period for erecting production capacity should provide for maximum usefulness of this capacity at introduction (national-economic significance, progressiveness, and so on).

7. Reduction in the cost of production capacity being erected and a rise in the level of concentration of capital investment at a facility that is under construction will serve as reserves for lowering construction time. An increase in the existing level of concentration of up to 1.0 will enable specific time to be reduced, from 0.54 percent in power machinebuilding to 33.2 percent in tractor and agricultural machinebuilding.

In coming years it will be possible, in acting through these factors alone, which exist in the spheres of planning and financing of capital construction and the performance of these operations, to reduce the construction time lag in machinebuilding by about 1.5-fold, enabling the flexibility of the production of the tools of labor to be raised.

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NEW METHOD OF LARGE PANEL CONSTRUCTION DESCRIBED

Moscow STROITEL'STVO I ARKHITEKTURA MOSKVY in Russian No 5, May 81 (signed to press 6 May 81) pp 5-7

[Article by V. Maksimenko, chief of the Technical Administration in the GlavAPU [Main Architectural and Planning Administration]: "KOPE, A New Method of Large Panel Housing Construction"]

> [Text] To improve the quality of planning, architectural and structural resolutions...
>
> To develop advanced forms for organizing construction in every way possible...
>
> To improve the level of industrialization for construction production and the degree of factory preparedness of structural components and parts...
>
> From the Main Directions of Economic and Social Growth in the USSR for the years from 1981 to 1985 and the period to 1990.

Practical application over recent years has shown that modern urban construction concepts, which are based on more completely satisfying social, economic and architectural demands, may be realized completely and as a unified whole only by strictly coordinating the architect's plans with the realistic capabilities of the construction industry.

The economics of mass production require not only standardization of the product being turned out but also its constancy--a necessary condition for the steady pace of enterprises' operations. In other words, beyond the dependence on the number and types of housing units that are turned out as a final product, the number of brands of products that are manufactured by enterprises in the construction industry should be practically unchanged for a certain period (with a constant numerical proportion of them).

Solving urban construction and demographic problems by means of adopting new types of large panel housing units or modular sections must, therefore, be done on the background of a steady pace of work for housing construction combines and at the same time must not reduce their capacity nor require additional expenditures for reconstructing or reequipping industry.

Attempts at solving this contradiction between variety in urban construction and production limits have been going on for a number of years. The development and adoption of the Common Catalog of Industrial Products created the preconditions for achieving success in this area.

We would remind you, however, that the "open system of standardization," i.e., freely forming housing units from products out of the catalog, which was accepted as the general strategy in developing large panel housing construction, while meeting urban construction requirements and ensuring a constancy in the products list, does not, at the present stage, solve the problem of turning out the products that go into it at a steady pace on time. A similar deficiency afflicts the modular section method of production loading as a final result to a limit in the output of the varieties of modular sections.

A new system of providing many variations in housing construction design and manufacturing has been worked by the administration of "Mosproyekt-1" in collaboration with the Moscow State Association of Large Panel Housing Construction in the Main Moscow Construction Administration, based on products from the Common Catalog and on a high level of standardization for design components. It is called the "Catalog Spatial Planning Elements Method (KOPE)" by the name of the primary planning element of typification.

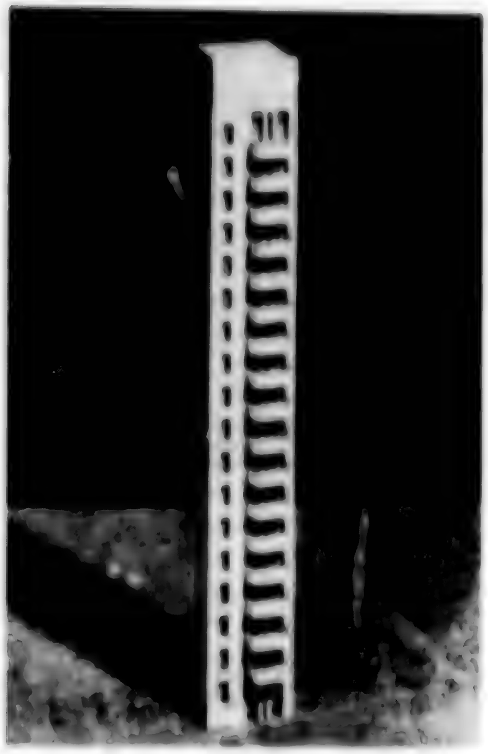
The principal aim of the method is to achieve urban construction and spatial planning variations and to individualize structures while providing a steady pace and constancy of production by means of stabilizing the products list and minimizing the number of brands.

Catalog spatial planning elements and catalog modular elements (KEB) are a method towards a solution, the combination of which is a means of forming housing sections and housing units with varying stories and floor plans.

The spatial planning elements are a part of a housing section--from the foundation to the roof. There is a varying composition of apartments or other functional parts of the building in it such as, for example, the stair and elevator core area. The industrial products from the Common Catalog are the structural basis.

Each element--a possessor of the basic functional and compositional features of the future housing unit--is a self-contained unit and has the capability of being a modular section with other elements when forming sections and a housing unit.

Basic composite typical housing sections are developed for forming a production plan for an estimated period of time. All of the types of KOPE occur in them in proportions that correspond to the annual volume of products from housing construction combines and the average annual pattern of construction while taking into consideration the demographic requirements and the demands for an amount of longitudinal, latitudinal, corner, turning, spot, varying story and other combined compositions of buildings. The number of basic sections must be kept to a minimum.



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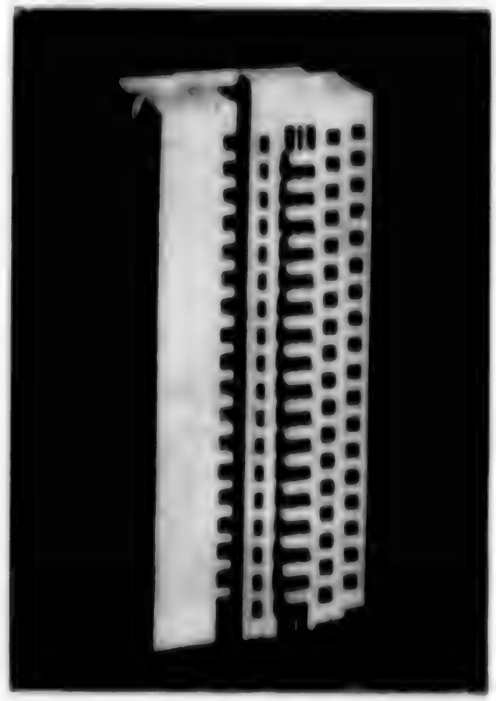

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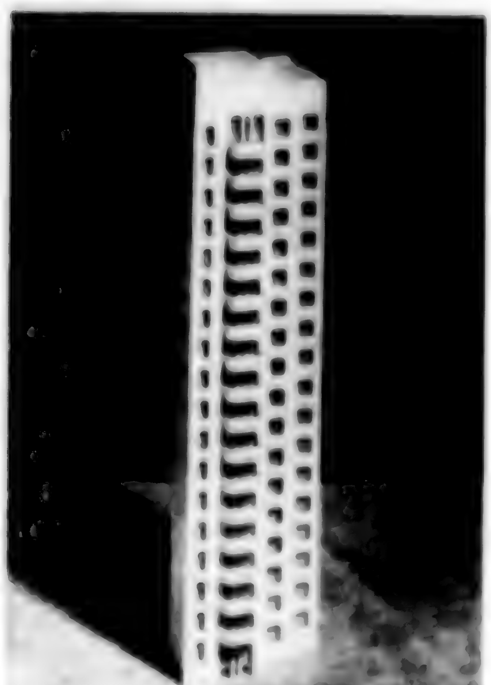


b)

Fig. 1. Forming large panel housing units by the KOPE system:

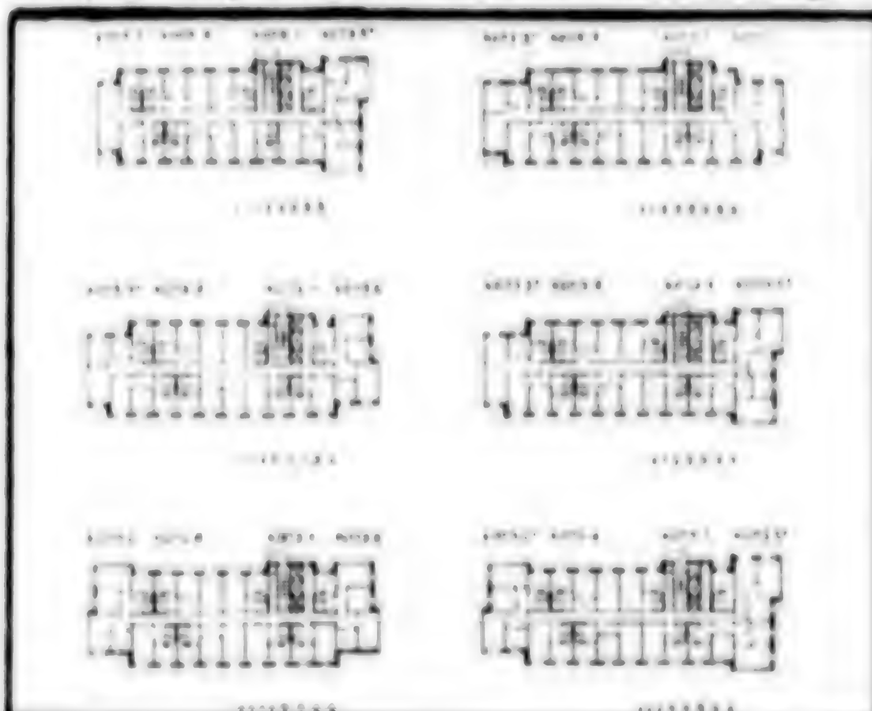
a. Catalog spatial planning elements (KOPE)
b. A grouping of portions of sections from 2 KOPE
c. A grouping of sections from 3 KOPE

Derivative sections are formed on the principle of base sections utilizing them in the required combinations that comprise their KOPE. When this is done the total number of catalog spatial planning elements that are in production at the same time must be constant and correspond to the production planning matrix.

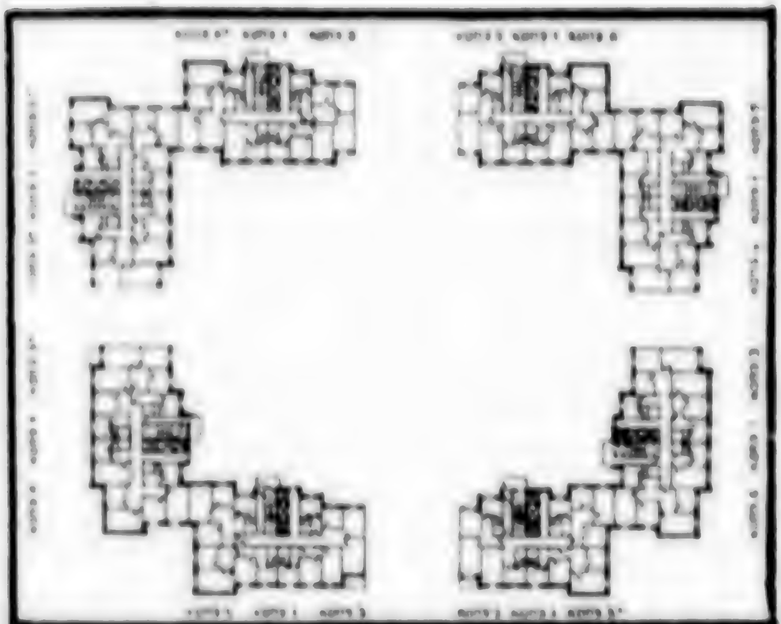
Typical catalog housing sections, formed from modular elements, are the secondary elements of typification.

Forming primary and secondary elements of typification must be done on the basis of the timely development of plans for locating construction work and projects.

The catalog sections are divided into longitudinal and latitudinal (depending on the orientation) which, in turn, are divided into common and turning.



3. A scheme for forming catalog housing sections (KTZhS) from catalog spatial planning elements (KOPE)



4. Examples of modular housing units based on KOPE

Modular elements are specified for forming housing units from catalog sections including common and butt end (left, right) varieties; for warping joints and forming shifts in plan view; warped joints with drops in elevation in section view; with changes in elevation and shifts; for modular sections with an angle of 30° and 45° and others.

With the aim of regulating the products list that results from forming shifts and drops in elevation, latter ones are specified to exactly conform to the modulus of the shift and the modulus of the drop in elevation.

The modular element products list must correspond to all of the possibilities for grouping sections that are specified by the system. Only the interior walls are a part of the modular elements for the entire height which includes basement (mechanical cellar) panels, garrets, frieze panels, and also foundations and takes into consideration the features of each element (the shift, change in elevation, turn).

The set of housing units that are formed on the basis of the new method must satisfy overall urban construction requirements including the total demographic balance or the demand for housing units with uniform or mixed combinations of apartments with their features for an estimated period of time; the structure of the building; the ratio of housing units with certain stories, length (sectional size), orientation and configuration; the demand for compositional variations and the ratio of housing units that have non-housing first floors.

The most representative types of housing sections selected which make it possible to obtain an optimum ratio in the variations of large panel buildings with given spatial planning characteristics are laid as the foundation for developing a series.

Planning production is done with the aid of a special matrix in which the output of spatial planning elements is set as a constant. The plan is divided into years, quarters, months, weeks, and days. Plant production is synchronously linked to the planning of design work, "the tying in" and construction which ensures that all of the plant's products are completely utilized.

Supporting and regulating the normal operating conditions of the design and production complex is ensured by organizational, technical and technological measures that are based on strictly observing certain conditions and limits.

Production enterprises do not use typical housing sections as the designed planning unit but a spatial planning element with the full complement of products that are required to form it. This makes it possible, on the one hand, to organize the synchronous manufacturing and delivery of products to the construction site according to a common schedule, aids in regulating estimates and bookkeeping for equivalent indices and, on the other hand, guarantees variety in housing units.

Establishing the basic parameters of spatial-planning elements and determining their products list is a more crucial stage in completing typical design and estimate documentation.

All of the combined compositions for modular housing units are revealed during the technical design stage and the given program is checked as to its conformity with the plan for locating construction and the detailed planning programs.

The designing system based on KOPE assumes: a systematic numerical estimate and analysis of the use of this or that housing section; the appearance of demand for new types and combinations; an estimate and allocation of the existing section designs between the studios for inclusion in the title list of design work with compulsory adherence to the ratios being used for the fixed period of time; an analysis of the demand by studios for new sections; drawing up programs for working out new types of designs for spatial planning elements.

Composite specifications for products are made up only for individual sections and not for the housing unit as a whole.

It is assumed that when forming housing units only the variable part of the design and estimate documentation is "tied in." The entire remaining portion of documentation, which is grouped in the invariable part of the typical design, must be handed over to the client and to the construction organization centrally, bypassing the design studio that does the tying in.

Making up housing units at the tie-in stage is done only from basic and derivative sections.

In order to make the calculation of the variable conjuncture easier it is recommended that working out tie-in designs be done with provisions for space.

The design and production complex for building on the basis of KOPE must be an interrelated system in which all organizations that participate in the formation of large panel housing units originate with the basic principles and conditions that meet the requirements of industrial housing construction.

The automated system for controlling designing, production and construction must ensure that the output of products is sustained and regulated with the aim of preserving the constancy and steady pace of production and construction.

It is expected that all of the processes within the design and production complex will be regulated in a computer center with the assistance of coordinating services.

By means of accurately implementing all of the processes and observing the rules of planning, designing, production and construction it is possible to automate all of the processes in stages with the aid of an EVM [electronic computer].

Under the conditions of actually implementing the method the following restrictions and specific features were adopted for DSK-2 of the Main Moscow Construction Administration:

the spacing of the transverse load-bearing walls is identical--3.6 meters;

making modular sections by "blank" butt ends which makes it possible to avoid using special corner sections and as a result reduce the number of size-types and brands of products that are required to complete the overall program;

a stair and elevator core area in a 7.2 x 7.2 m module that is identical in components for all the possible cases of housing units with 22 to 25 floors with minor modifications for the gradations of stories;

a system of exterior enclosures with raised work and balcony structures in the form of hung (on the exterior enclosures) spatial elements that are factory prepared.

Fifteen types of 22-story KOPE (6 of them are mirror like) were worked out by the "Mosproyekt-1" Administration. The total number of brands is about 700; of those, 20 are intended as housing first floors with increased tension in the load-bearing walls; 30 are for the foundation cycle; 99 are for the stair and elevator core area; 77 are for non-housing first floor components; 50 are for forming balconies, verandas and projections; and, 134 brands are for three layer enclosure panels.

The cost of one square meter of common area in the 18 to 22 story housing units that were designed by the "Mosproyekt-1" Administration from spatial elements comprises 186 and 190 rubles, respectively, and does not significantly differ from the cost of 16-story housing units made of products from the P44/16 (180 rubles) and P3/16 (173 rubles) catalogs.

The first designs for housing structures that were formed from spatial planning elements showed the possibility of increasing the compactness of the structure by flexibly adapting planning approaches to local conditions and by improving its economic effectiveness accordingly.

The Urban Construction Soviet reviewed the design approaches for the multi-storied large panel housing units that were worked out on the basis of the KOPE method and acknowledged it as a long term approach to the development of industrial housing construction which makes it possible, based on the Common Catalog, to achieve more variety in construction than by using the modular section method (while ensuring the constancy and steady pace of production and limiting the number of brands and products).

At the same time the Urban Construction Soviet noted a number of deficiencies in the technical engineering and architectural planning manner of actually implementing the method and recommended that the "Mosproyekt-1" Administration, in conjunction with a large panel housing construction association, include the necessary changes and additions in the designs.

The production and construction of the first housing units on the basis of spatial planning elements, which is the start of an extensive experiment, should begin at DSK-2 in 1981.

Housing units with an area of about 16,000 square meters will be built in microrayons No 16b and 16V of Vorontsov and with an area of about 190,000 square meters in Bibirev. The formation of monolithic reinforced concrete bureaus is contemplated in Yasenev near such housing units for organizing the (non-housing) first floors.

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RATIONAL USE OF LOCAL RESOURCES DESCRIBED

Moscow STROITEL'STVO I ARKHITEKTURA MOSKVY in Russian No 5, May 81 (signed to press 6 May 81) pp 19-20

[Article by A. Zemtsov, scientific worker at MIU [expansion unknown] imeni S. Ordzhonikidze and V. Pen'kov, assistant professor at MIU imeni S. Ordzhonikidze and candidate of economic science: "Cost Accounting for Territorial Resources; Problems of Increasing the Technical Level of Production"]

[Text] Increasing the volumes of industrial products that are manufactured is a necessary precondition for satisfying the constantly growing material demands of society. With extensive management methods this problem is solved by means of building new enterprises and recruiting additional labor forces. The extensive methods of development have not lost their significance even today for certain rayons of our country. However, in the large industrial centers (regions) that have already been formed, one of which is Moscow, the basis of growth in the volume of products that are turned out can only be an intensification of production--in view of the limited nature of a number of resources, especially labor and territorial resources.

In the Principle Directions of Economic and Social Development in the USSR for 1981 to 1985 and for the Period to 1990 it specifies that measures be implemented for transferring the economic structure of such regions to a primarily intensive method of development.

An increase in the technical level of enterprises will serve as the material basis for solving the problems of intensifying Moscow's national economic structure, i.e., forming such organizational and technical manufacturing conditions that provide an increase in the output of products in the real sense with constant total expenditures for human and mechanical labor. When this is done the consumption of all types of resources used in a product unit is reduced while increasing the technical level of production.

In our opinion territorial resources, which we understand to be the lots of industrial buildings and the parcels of land that have been set aside for industrial construction, should also be included (along with the material and labor resources that are already considered) with the number of Moscow's valuable resources whose economy is accomplished by means of an increase in the technical level of production.

It should be noted that one portion of the territorial resources, namely the production area, has long ago been included in cost accounting since an enterprise makes an annual payment in the amount of 6 percent of the cost of the building for it. Consequently, an economic mechanism exists that promotes its efficient use. And yet a plant's territory, and also lots that have been set aside for industrial construction, are still not an object of evaluation in the monetary sense and are not included in the system of cost accounting relationships.

At the same time the expediency of an economic evaluation of the most important natural resources, for example, agricultural land, forests, mineral resource deposits, etc. is not in doubt. Such an evaluation is being done more all the time. Apparently the principles, on which cost accounting for natural resources is based, may also be applied for developing a system of reimbursement for the use of Moscow's land resources (with the aim of economically regulating the location of enterprises and improving the validity of the size of the urban area that is used by them).

A certain amount of work has already been done along these lines by the NII [Scientific Research Institute] of the Economics of Construction in USSR Gosstroy, by whom recommendations were worked out for an economic evaluation of the territory that has been set aside for construction.* But, unfortunately, the above method is still too complicated and allows for ambiguity in determining the cost of territorial resources and is intended primarily for a relative, i.e., comparative evaluation of the lots that are intended for construction.

The availability of an absolute and unchangeable value for the cost of a territorial resource unit is a necessary condition for the majority of practical calculations. In particular, it is precisely the absence of such a uniform scientifically valid and approved "price list" for various urban lots that is hampering the adoption of the principle of utilizing this type of resource by cost accounting. We believe that without such a "price list" it is also impossible to make a sufficiently accurate technical and economic basis for the designs for building, expanding, and reconstructing enterprises.

Ignoring the value of evaluating land can lead to erroneous conclusions and decisions. The possible losses due to the inefficient use of urban territory will increase over the course of time since the constant development of the Moscow infrastructure inevitably involves an increase in the cost of territorial resource units. Even now, based on the calculations of a number of a thors, one hectare of these resources costs the state an extremely imposing sum. For example, S. Lyashchenko values one hectare of urban land at approximately 700,000 rubles (see STROITEL'STVO I ARKHITEKTURA MOSKVY, 1978, No 4, p 4). S. Kabakova, using a number of engineering and economic criteria, singled out five zones in Moscow and differentiated the "value" of one hectare from 1 to 1.1 million rubles in the center of the city (the first zone) to 150,000-200,000 rubles in the fifth zone--from the Moscow circuit railroad to MKAD [Moscow circumferential highway] (see EKONOMIKA I ORGANIZATSIYA PROMYSHLENNOGO PROIZVODSTVA, 1973, No 1, p 141). With such expensive hectares measures that both concern the opportune relocation

*Methodical Recommendations for an Economic Evaluation of Territory That has been Set Aside for Construction, Moscow, Institute of Economics, 1976

of certain industrial enterprises that have a low "return" from territorial resources beyond the boundaries of Moscow (which S. Lyashchenko suggests) and also create conditions that promote a significant improvement in the technical level of production for all operating enterprises and the efficient use and construction of plant territories are extremely urgent.

The problems that have been presented may only be solved in the event that the monetary evaluation of urban territory is taken into consideration, first, when calculating the efficiency of capital investments (see Appendix 1).

Secondly, when establishing the annual payment for a parcel of land that has been set aside as a plant's territory.

As a result of these measures the territorial resource will become an integral part of the procedure for working out designs, reequipping, reconstructing and expanding industrial structures. It may be considered in all calculations that are related to the soundness of the technical level of production and the expediency of locating an enterprise in a given urban rayon. And a required payment for such a resource forces enterprises to correlate its size with the end results of production and helps to draw an opportune conclusion about the expediency of reconstruction that is aimed at adopting new techniques, increasing the number of floors in industrial buildings and building on the vacant lots that still exist at several enterprises.

Including a cost evaluation for urban territorial resources in the criteria for selecting the variations of capital investments makes it possible to more validly determine the socially required minimum boundaries for the technical level, specialization and concentration of production. While creating a "price list" that serves as the basis for a monetary evaluation of parcels of land, urban planning agencies may take into consideration the degree to which there is a deficiency of land that is suitable for construction and the cost of the infrastructure in this or that rayon of Moscow. With a relatively high "value" for the land being used, enterprises will have to increase the technological capacity of the production processes by means of additional capital investments in new techniques since only a high technical level ensures the standard efficiency and profitability of production required under the conditions of an expensive infrastructure.

We believe that the liability for forming above standard reserve territorial resources will increase to a greater degree if urban enterprises and associations make an additional increased payment for them. When this is done, it is important that it be collected not by means of reducing the spare profit balance that is paid to the state budget but that it be reflected in the size of the economic incentive funds.

Payment for production funds, which was adopted at one time, stimulated their efficient use and induced enterprises to rid themselves of unnecessary stores of material value. A similar effect, which is reflected in economizing urban territory, can be expected from the introduction of payment for territorial resources. This measure can render considerable aid in preserving the existing boundaries of the city.

Enterprises have two basic means of increasing the intensity of using production areas. They may conditionally be called organizational and technical. Measures that promote

more efficient spatial accommodations for existing means of production, an improvement in the layout of a plant's territory and the use of underground space are related to the first. Improving the material base, i.e., increasing the technical level of enterprises which makes it possible to significantly increase the output of products within the existing boundaries of territory that have been set aside for industrial enterprises is related to the second.

A number of inspections of enterprises testify to the presence of great possibilities for absolutely and relatively freeing territorial resources (see Appendix 2) by means of the technical factor. For example, in the opinion of S. Yusepchuk, at machine building enterprises the "necessity of using considerable production space for assembling products is explained by the lengthy production cycle for assembly as a result of the low level of mechanization and automation of production. This is caused by the difference between the high relative proportion of space and the low basic funds for assembly production which makes it possible to draw a conclusion about the availability of potentials for using production areas." (see VESTNIK MASHINOSTROYENIYA, 1976, No 4, p 8).

The low technological level of production in the auxiliary shops at many enterprises also reduces the indices for the use of territorial resources (see table).

Conducting regular inspections makes it possible to evaluate and analyze on the whole the degree to which the organizational and technical factors for economizing territorial resources are used by Moscow's enterprises. The socially required (or standard) level for the value of the indices (see Appendix 3) must serve as the basis of comparison during analysis.

The cost accounting nature of territorial resources in no way means that having any kind of reserve territory is prohibited. For such phenomenon are observed in the economic structure as, for example, the aggregate concentration of production where the overall dimensions of the implements that are used for the work are increased as a result of which a problem in accommodating them can arise. Increased demand for a certain product can also bring about the necessity of expanding an enterprise.

It is important to compel enterprises to evaluate the size and efficiency of maintaining such reserves (see Appendix 4). The inclusion of parcels of land in the cost accounting relationships is a necessary prerequisite for creating a unified planning and economic mechanism, with the aid of which both the technical level of production and the use of territor'al resources can be controlled.

APPENDIX

1. ESTIMATING THE COST OF TERRITORIAL RESOURCES WHEN USING THEM AS A BASIS FOR THE ORGANIZATIONAL AND TECHNOLOGICAL LEVEL OF OPERATING AND PLANNED ENTERPRISES

Selecting the variation of an enterprise's organizational and technical level is done with the aid of the criteria:

$C_i + E_n (K_{ed.} + K_{ter.} + K_{tup})_i$ min.

where S_i is the cost of the annual output of products for the ith variation of utilizing territorial resources and the technical level of production, rubles;

K_{tup} is the capital expenditures for acquiring new equipment to increase the technical level of production, rubles;

$K_{zd.}$ is the capital investments for creating industrial production space (the cost of construction work), rubles;

$K_{ter.}$ is the cost value of the parcels of land that have been set aside in the given rayon of the city as a plant's territory, rubles;

E_n is the standard coefficient for the effectiveness of capital investments.

2. DETERMINING THE ANNUAL EFFECT FROM ECONOMIZING TERRITORIAL RESOURCES BY MEANS OF INCREASING THE ORGANIZATIONAL AND TECHNICAL LEVEL OF PRODUCTION

The annual effect (E_{pr}) of increasing the "return" from industrial production space is equal to $E_{pr.} = TS_{pr.}(K^{on}_{5.2} - K_{5.2}) \cdot P$; the annual effect ($E_{zav.}$) of increasing the "return" from an area of a plant's territory is equal to $E_{zav.} = TS_{zav.}(K^{on}_{5.1} - K_{5.1}) \cdot P$,

where $TS_{pr.}$ is the cost of one square meter of industrial production space, rubles;

$TS_{zav.}$ is the cost value of one square meter of area of the plant's territory, rubles;

P is the annual volume of products that are turned out at the enterprise in real measurements or in cost measurements (in rubles of pure production);

$K^{on.}_{5.1}$, $K^{on.}_{5.2}$ are the socially required or standard level for the value of the indices that characterize the demand for territorial resources for producing product units in the real sense or for 1 ruble of pure production.

If negative quantities are derived in the formulas then this testifies to the poor organization of utilizing territorial resources and to the low, morally outmoded technical level of production at the given enterprise.

3. SELECTING THE BASIS OF COMPARISON FOR ANALYZING THE INDICES FOR THE USE OF TERRITORIAL RESOURCES

The socially required level of the values of the coefficients $K_{1.1} \div K_{6.2}$ is calculated by the formula $K = \frac{\sum_{i=1}^{n} K_i d_i}{100}$, where K_i is the value of the coefficent for the ith enterprise, d_i is the ith enterprise's proportion of products that are turned out by a p group of related enterprises--in percent.

The standard level for the values of the coefficients that are determined on the basis of an analysis of advanced designs that are created for enterprises of a given type may be used instead of the socially required level.

4. EVALUATING THE EXPEDIENCY OF ENTERPRISES MAINTAINING EXISTING RESERVE TERRITORIAL RESOURCES.

The annual losses of profits and the (U_{god}) related to maintaining temporarily unused territorial resources result from payments for production funds, payments for parcels of land that are set aside as a plant's territory and losses due to increased amortization deductions:

$$U_{god} = \frac{(\eta_1 + N_a) \cdot W_1}{100} + \frac{\eta_2 \cdot W_2}{100},$$

where η_1 is the standard payment for production funds, percent;

η_2 is the standard payment for using parcels of land that are a plant's territory, percent;

W_1 is the cost of the reserve industrial production space (determined by multiplying the cost of one square meter of space by the total size of the reserve space in square meters), rubles;

W_2 is the cost value of the reserve space of a plant's territory (determined by multiplying the value of one square meter of the plant's territory by the area of the reserve territory in square meters), rubles;

N_a is the standard for amortizing the industrial building in which there is reserve space, percent.

The total losses of profit (O_p) from the time that the reserve territorial resources are formed up to the moment that they are used is determined by the formula: $O_p = U_{god} \cdot T$,

where T is the time before the onset of demand by the enterprise for additional territorial resources in years.

The reserve territorial resources that are maintained by an enterprise are economically justified only in the case where the following conditions are implemented:

$$Z_{ter} + O_p \quad KV_t + D_p \cdot t_g,$$

where KV_t is the capital investments for creating additional territorial resources (with a lack of reserves) over t years at the moment that the reconstruction or expansion of an enterprise is done, rubles;

t_g is the time for forming additional space accompanied by a halt in the production process, days;

D_p is the daily losses of profit due to the halt in the production processes in connection with the fomration of additional area, rubles;

Z_{ter} is the losses due to freezing capital investments in reserve territorial resources, rubles.

TABLE			
PRINCIPAL INDICES CHARACTERIZING THE USE OF URBAN TERRITORIAL RESOURCES BY ENTERPRISES			
No. in Succession	Name of Index	Formula for Calculations	Designations in the Formulas
1	Coefficient of utilization of a plant's territory	$K_{1.1}=\frac{S_o}{S_{zav.}}$ $K_{1.2}=\frac{W_o}{W_{zav.}}$	$S_{zav.}$--the area of the plant's territory, square meters S_o--the industrial production area of the buildings, square meters
2	Coefficient of technical saturation (level of being equipped) for a unit of territorial resources	$K_{2.1}=\frac{A}{W_o}$ $K_{2.2}=\frac{A}{W_{zav.}}$ $K_{2.3}=\frac{A}{S_{zav.}}$ $K_{2.4}=\frac{A}{S_{zav.}}$	A--the cost of the active portion of production funds, rubles W_o--the cost of the industrial production space in buildings, rubles $W_{zav.}$--the cost value of a plant's territory, rubles
3	Coefficient of utilization of industrial production space over time	$K_{3.1}=\frac{S_1+S_2+S_3}{3 \cdot S_1}$	$S_1S_2S_3$--the area where equipment operates correspondingly during the first, second and third shifts, square meters
4	Coefficient characterizing the structure of industrial production space by type of equipment installed in it	$K_{4.1}=\frac{S_{pr}}{S_o}$	S_{pr}--the area in which advanced highly productive types of equipment have been installed that provide a high technical level of production, square meters
5	Coefficient characterizing the demand for territorial resources for producing a product unit (in the real sense) or for 1 ruble of pure production	$K_{5.1}=\frac{S_{zav.}}{P}$ $K_{5.2}=\frac{S_o}{P}$	P--the annual volume of production in the real sense or in a cost expression, units or rubles of pure production
6	Coefficient reflecting the effect of the technical level of production on the "return" from territorial resources	$K_{6.1}=\frac{R}{W_o}$ $K_{6.2}=\frac{R}{W_{zav.}}$	R--the final results of production: the volume of pure commodity production or profit (for a year) rubles

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